SAE Journal

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A. T. Colwell, President **David Beecroft, Treasurer**

John A. C. Warner, Secretary and General Manager

Norman G. Shidle, Executive Editor

About Authors

Some 145 United States patents have been issued on inventions of ROLAND CHILTON *(M '16), consulting engineer, in charge of the research division active on advance designs for the Wright Aeronautical Corp. Among his inventions now in production are inertia starters, dynamic dampers, 2-speed supercharger drives, propeller reduction gears, and torque meters. Mr. Chilton was chief engineer of Fergus Motors, England, when he left to come to America in 1917. In this country, prior to joining Wright Aeronautical in 1929, he was chief engineer of the Aeromarine Plane & Motor Co., in charge of aircraft engines, starters, and buses.*

JOHN B. MATHES *has been with the Dow Chemical Co. since 1935 as engineer for the Dowmetal Division, active in the various developments which have increased the demand for magnesium from 4,000,000 lb in 1935 to a probable 30,000,000 lb in 1941. His entire time, since 1939, has been devoted to the development of wrought magnesium alloys in aircraft, working with the various airplane companies and correlating the research and production of his company in this field to their requirements. Mr. Mathes attended the University of Michigan, graduating in 1928 with the degree of B.S.C.E.*

C. G. A. ROSEN *(M '37) developed his ability as a writer some years ago when, as a sideline, he contributed articles to several motorboat publications and was author of one and co-author of another diesel-engine correspondence course. At that time he was engaged in consulting work on the design, construction, installation and maintenance of diesel powerplants, and instructor in diesel engines for a University of California Extension Course. Since 1929, Mr. Rosen has been engaged in the development of mobile diesel engines for the Caterpillar Tractor Co., of which he is assistant chief engineer in charge of diesel research. He is just concluding a term as SAE vice president representing diesel-engine engineering.*

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MILITARY MEN SPUR SAE TO DEFENSE PEAK

at 1941 Annual Meeting in Detroit

AN exhibit of motorized military equipment furnished jointly by the Quartermaster Corps and the Ordnance Department of the U. S. Army was displayed on Washington Boulevard throughout the meeting and was inspected by hundreds of automotive engineers during this time.

"I HAVE an abiding faith in our democratic institutions, in the capability of our industries, in the intelligence of our workers, and in the American people."

That statement, made by Major-Gen. Charles L. Scott, Acting Chief of the Armored Force, sounded the keynote of the industrial and technical discussions of national defense which dominated the 1941 Annual Meeting of the Society of Automotive Engineers at the Book Cadillac Hotel in Detroit, Jan. 6-10.

Top ranking military and defense officials on the one hand and automotive technicians and industrial leaders on the other echoed this belief in the industrial striking power of democratic methods throughout the week. And they backed up their beliefs by detailed rehearsals of facts about production records already achieved on defense projects and by outlines of specific methods and projects designed further to speed up progress in this field.

■ Engineers Praised

Two things were made clear at the Detroit gathering. First, the automotive technicians have done a great job on national defense to date. They have been able to achieve everything that could reasonably be expected of them under existing conditions. With practically every important military and government defense leader speaking during the week, no voice was raised in criticism of what the automotive managements and their engineering staffs have done so far. Second, it was made equally clear by these leaders that speed – and more speed – is essential from here in; that automotive men must be called upon to do the impossible in some respects. But confidence was expressed in their ability to come through because of the fact that they had done so on peacetime projects time and again during their 40 year history.

Gen. Hugh S. Johnson, speaking in place of OPM chief W. S. Knudsen at the Production Session on Thursday evening, voiced a typical opinion about the sort of results that will be expected of the automotive industry and its engineers when he said with characteristic directness: "Industry has got to do its stuff. That stuff can't be any ordinary business-as-usual, workaday performance such as we see in peace. *You have got to perform miracles!*"

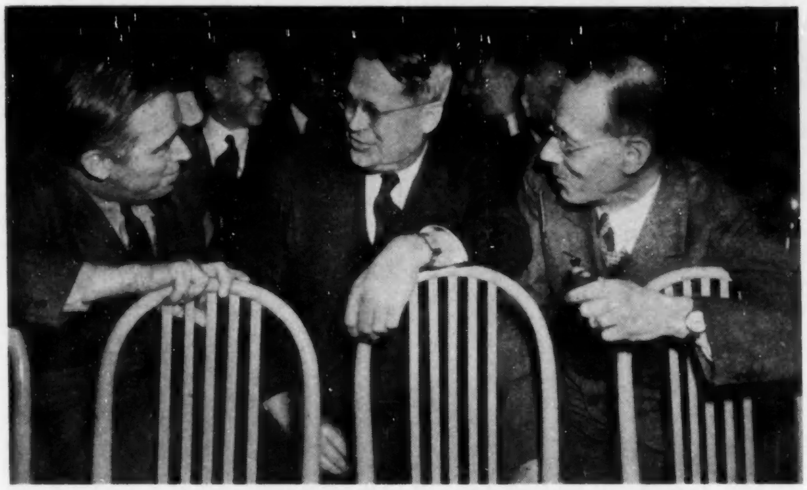
■ Distinguished Speakers

A program studded with speakers like Quartermaster Gen. E. B. Gregory, Navy Bureau of Aeronautics Chief Rear-Admiral J. H. Towers, Armored Force Acting Chief Major-Gen. C. L. Scott, Chrysler President K. T. Keller, Gen. Hugh S. Johnson, Brig.-Gen. O. P. Echols (representing Major-Gen. G. H. Brett, Army Air Corps Chief), and others brought a dynamic direction and vitality to the strictly technical portions of the meeting which has seldom before been equalled.

Attendance at sessions throughout the week broke record after record. Aircraft, diesel-engine, passenger-car, transportation and maintenance, fuels and lubricants sessions, all brought crowds which overflowed available meeting space and discussions which cut deep into the heart of immediately pressing technical problems.

The sessions bearing on national defense – which dominated the meeting as a whole – were so eagerly sought out that "standing-room-only" signs went up in every instance.

Added to the list of distinguished leaders of American



Waiting to hear the Quartermaster General speak. SAE Past Presidents D. G. Roos, J. H. Hunt and B. B. Bachman

defense and industry appearing at this 1941 Annual Meeting was Sir Louis Beale of the British Purchasing Commission whose stirring message at the dinner on Wednesday evening flashed bright, new illumination on vital phases of British-American relationships in the fields of industry, engineering and defense. Sir Louis made his address following brief opening remarks by Detroit Section Chairman L. A. Chaminade, an expression of appreciation by 1940 SAE President Arthur Nutt for the cooperative efforts of the Society during his administration, and a vital inaugural talk by 1941 SAE President A. T. Colwell.

Toastmaster at the Dinner was L. C. Hill, Murray Corp. vice president and chairman, SAE-Quartermaster Corps Advisory Committee.

Sir Louis Beale Brings Vital Message

"The hope for complete British victory, for freedom, lies in the engineering industry of the United States. There lies the hope of all those who are fighting for freedom. American industrial aid is essential to victory," Sir Louis declared, and told the automotive engineers that "this war is a war waged with the products of your own skill – a war of machines. It will be won in your factories and ours."

American aircraft, Sir Louis stated, "have played an especially fine part in our grim struggle ever since the start . . . whether on winter patrol over the North Sea . . . in raids over Europe . . . in the Mediterranean and Near East, or on patrols over the Atlantic . . . their reliability has been remarkable . . . their flying qualities in all weathers and under extremely arduous conditions are greatly appreciated by British pilots."

The thousands of trucks, tractors, and the like which have been secured from the United States and Canada, he reported, are without exception excellent in every way. "Much of our success in Egypt and Libya has been due to the excellence of the mechanized equipment so largely drawn from the United States and Canada," he declared.

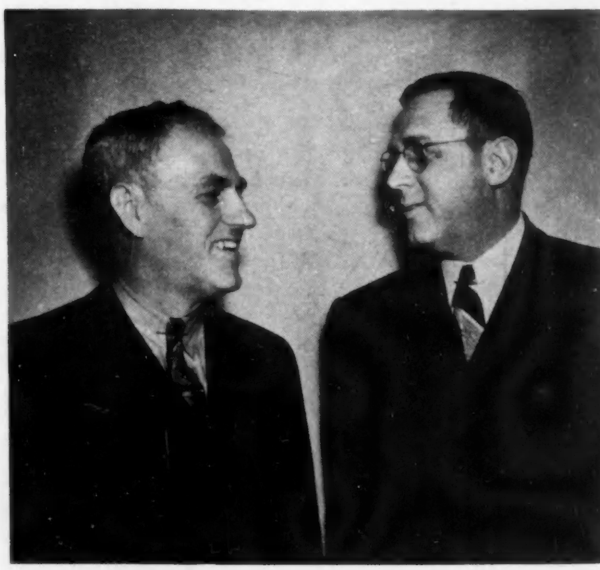
In addition to design and production, Sir Louis continued, the furnishing of spare parts and the maintenance and upkeep of units in the field are almost as important as manufacturing itself, and the high degree of interchangeability of parts in American vehicles enhances their service, particularly in war.

"Britain's need for more and more planes is urgent," he declared, "particularly medium- and long-range bombers with heavy bomb loads. Your long-range bombers are – for reasons of which you are well aware – now delivered with ease to Britain."

Commenting on the great air battles of 1940, Sir Louis quoted British Air Ministry figures revealing that during the year. 4974 enemy planes were destroyed in the air, against 1744 British. These figures, he said, do not include losses for either side in North Africa nor planes destroyed on the ground.

German planes destroyed over Britain, he continued, numbered 2993 against 847 British fighter planes, but in addition, British anti-aircraft took a toll of 444 German planes. The Italians alone lost 416 planes in aerial combat, against a loss of 75 for the British. In the Norwegian campaign losses were about equal; the Germans lost 55, the British 56; but in the Franco-Belgian campaign Germany lost 954 planes and the British 375. British bombers lost over German territories number 374.

Turning to the merchant marine, Sir Louis said, "we need more ships, and then more. . . . There have been considerable losses recently, and furthermore our ships now have to make far longer hauls than in peacetime." Priority in loading ships, he noted, is given to the heavy requirements of the day-to-day and week-to-week needs of certain areas, such as, for instance, the Middle East and the Greek theatre of war. Naval craft have priority in ship building. If, he said, the food situation ever were to become serious, it could be remedied without fatally endangering Britain's

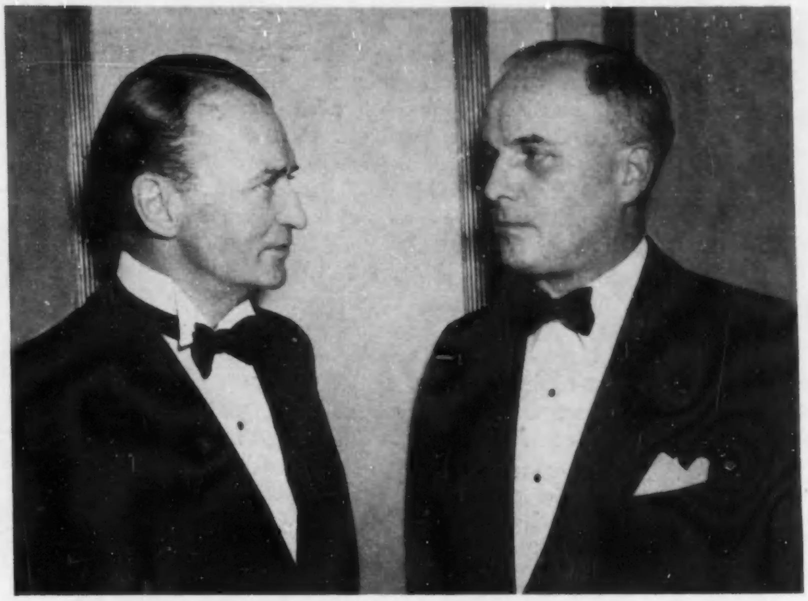


Arthur Nutt
1940 President

A. T. Colwell
1941 President

position in other spheres by reversing these priorities. "As an indication of the trend of events," Sir Louis added, "a few days ago Lloyd's of London adopted a war risk for cargo between India, Turkey, and via Greece, the first quotation on a voyage involving Mediterranean passage since Italy entered the war. . . .

"Despite the bombings of England, industrial production for all war purposes proceeds apace . . . no services of public utility – water, fuel, electricity, gas, sewage – have broken down . . . transport continues to run, and mail, milk, and bread are delivered each morning with a smoothness that seems incredible," Sir Louis stated. He also read a cable just received revealing that despite bombings and rationing, contagious diseases were far less prevalent in 1940 than they were in 1938 and 1939.



Banquet Speaker Sir Louis Beale of the British Purchasing Commission and Toastmaster L. C. Hill, Murray Corp. of America

Special tribute was paid by Sir Louis to the amateur – "It was the 'week-end' flyers of the Auxiliary R.A.F. who helped 'hold the ring' over Dunkirk and amateur yachtsmen who risked a strafing in small boats to take the men off the beaches. So, too, London owes a debt to the amateurs who compose her auxiliary fire-fighting services, her air-raid wardens, her stretcher parties, her ambulance drivers."

As to how many planes, guns, and tanks are wanted by Britain, Sir Louis said: "It is difficult to put our needs into exact figures, but a true answer would be that we need as many of these mechanisms of war as Germany has, and need them urgently . . . our needs are far, far greater than our present total supplies from all sources." He expressed confidence, however, that the British Empire's combined resources supported by the immense capacity of America's machine industry "will insure us in the end an overwhelming mass of power against Germany."

To SAE members and to American industry in general, Sir Louis said: "Our hats are off to you – we hope you will take your coats off for us."

Colwell Stresses "Quality and Research"

Keep quality up – and research going strong. That was the prescription for defense equipment progress given by SAE President-elect A. T. Colwell in his talk at the Annual Meeting Dinner. Recognizing fully the need for speed – and more speed – in production, Mr. Colwell stressed that quality must be kept up along with faster output, lest later maintenance troubles offset the value of increased production gains. Research too must be pushed just as vigorously as production, Mr. Colwell urged, pointing to continued technical superiority of our war materials as an essential of success in modern warfare.

To ensure this permanent high quality for American defense products, every American automotive engineer wants to keep abreast of the times, Mr. Colwell said, and stressed the value of SAE membership in achieving that end. "No other medium is equal to membership in the SAE," he said, "when it comes to keeping abreast of the times in our profession." He stressed especially the helpfulness of SAE contacts to younger engineers, pointed to the pride which members of all ages take in their affiliation with the Society, and urged management executives to give "a kindly nod of encouragement" to younger technicians ambitious enough to put time and energy into improving their abilities through SAE activities. Time thus spent, Mr. Colwell proclaimed, is not *spent* – it is *invested*.

Mr. Colwell decried the criticisms of American aircraft which have been appearing in recent newspaper articles, branding much of that criticism as "unjustified." The only real test of war equipment, he said, is war – and predicted that critics will have their eyes opened when they learn of the new equipment which the aircraft industry now has under way and when they see the actual performance results of that equipment in action.

Commenting on SAE accomplishments in the national defense program which Army and Navy officers had praised highly on preceding days, Mr. Colwell emphasized one important reason for the success of these SAE efforts – greater cooperation from these same officers and their service branches than had ever been achieved in any previous emergency. "We are dealing with men who *know* the automotive industry," he said.

The seriousness of our present national situation, Mr. Colwell said, probably can be appreciated fully only by reading between the lines of public speeches by President Roosevelt and other public officials. We are rapidly gaining that appreciation more fully, Mr. Colwell pointed out, saying that American industry is bringing into play its great genius for cooperative activity. Management, engineering, production, and maintenance – these groups *know* teamwork, Mr. Colwell stressed. "They will hit their stride," he concluded, "and when they do they will give our military services all the equipment those services need – and it will be the finest equipment in the world."

■ Business Session

Feature events of the business session of the Society on Tuesday evening, Jan. 7, were presentation of life membership to six founder members of the SAE and a review of 1940 Society work by President Arthur Nutt. The Founder Members to receive Life Membership in person at this meeting were David Fergusson and John G. Perrin. Those upon whom it was conferred *in absentia* were William P. Kennedy, Lt.-Col. Harry A. Knox, Arthur J. Moulton and Joseph Tracy.

On the following day, President Nutt in behalf of the Society presented a Life Membership to Henry Ford, also a Founder Member and the first man to hold the office of First Vice President of the SAE.

The proposed constitutional amendment revising the conditions of affiliate memberships was given its final reading by Constitution Committee Chairman L. C. Lichty and will now go to the entire membership for mail vote. (Details of this proposed change in the Constitution were printed in the SAE Journal for July, 1940, p. 20.)

The official report of the tellers of elections was read by SAE Secretary and General Manager John A. C. Warner and introduced by President Nutt, President-elect A. T. Colwell responded briefly in behalf of himself and the incoming officers of the Society for 1941.

PASSENGER-CAR & BODY SESSIONS

Chairmen

J. C. Zeder — **E. H. Smith**
K. M. Wise — **John Oswald**

Passenger-car and tire engineers wrangled about the advantages and disadvantages of wide-base-rim tires at one Passenger-Car Session; some hard-boiled truths about synthetic rubber and strategic metals were expounded at another; and color research in relation to car body fabrics was explored at a Passenger-Car Body Session. (The third Passenger Car Session – devoted to national defense problems – is reported on subsequent pages along with other national defense aspects of the 1941 Annual Meeting.)

Wide-Base Tire and Rim Construction – SIDNEY M. CADWELL, U. S. Rubber Co.

WIDE-BASE rims impose different conditions of strains in tires and emphasize certain inherent performance differences, some of which are advantages and others disadvantages, Dr. Cadwell pointed out. All tire structural and chemical functions with existing low-pressure tires and rims, he explained, have been carefully balanced over a period of years to complement the performance of the automobile in average service, as well as in extremes of service.

After a year of exhaustive testing by the combined car and tire industries, he reported, the wide-base rim proposal seems to have settled on the use of existing tire sizes on rims 1 to 1½ in. wider than at present, giving a rim ratio of 75 to 82% of tire width as compared with a ratio of 62 to 68% of the inflated width on existing tires.

The principal benefits of the proposed rim resizing combination, using present tire load-carrying capacity and 2 lb per sq in. lower inflation pressure, Dr. Cadwell declared, are: (1) considerably more stability in the car; and (2) a 20 to 22% increase in tire tread life. The latter figure, he explained, is an average of all tests of all companies.

"In addition," he continued, "our tests have shown that the wide-base tire and rim combination will perform somewhat better for: tire cord fatigue, tire rim bruise resistance, tire groove cracking resistance; would perform equally well for: tire heat dissipation up to 75 mph, tire power consumption, tire tread and fabric separation, tire sidewall breaks at the rim, tire squeal on turns, and tire noise or hum on straight roads; but would be inferior for: tire ride, tire harshness, pavement seam bump absorption, tire and car parking effort, rim curbing, and tire tread shoulder cracking.

"We approve the use of tires on wide-base rims," Dr. Cadwell concluded, "if the combined efforts of the car and tire engineers to re-balance the changed tire performance properties results in future cars of at least equal comfort and safety."

Rim Width as Affecting Lateral and Torsional Tire Stability – F. H. COMEY, B. F. Goodrich Co.

IT is commonly recognized, Mr. Comey pointed out, that a satisfactory tire must be more or less rigid to the following forces:

1. Radial Load – In order to provide a satisfactory ride, a deflection at normal load of about 15% is desirable.
2. Side Load – A high degree of stiffness is desirable to provide stability.
3. Circumferential Torsion – This has never been much of a problem with conventional tires. Friction clutches and flexibility of front springs offer some cushioning. Tires can be very rigid circumferentially and are in this respect.
4. Lateral Torsion – This is a measure of the force necessary to turn the tire tread out of parallel with the beads. Lateral torsional stiffness is largely synonymous with cornering power.

Mr. Comey reported on the effect of rim width on the radial, lateral, and lateral torsional stiffness of a tire as measured in his company's laboratory. Results of these tests were presented in the form of curves. Among other things, they indicated that, as rim width increases, an optimum rim width for lateral stability is reached for each inflation pressure; that the torsional rigidity is increased by increase in air pressure and by increase in rim width; and that the unit change in rim width has more effect on tire deflection as the rims increase in width. Finally, he showed a composite curve that considered all three factors simultaneously – "radial," "lateral," and "torsional" – with respect to rim width and inflation pressure.

Effect of Rim Width on Car and Tire Performance – R. D. EVANS, manager, Tire Design Research Development Department, The Goodyear Tire & Rubber Co.

THE fact that widening the rim on which a tire is mounted increases its lateral stability and its cornering power and decreases its radial deflectability, has been long recognized, Mr. Evans pointed out. In these respects, then, he continued, widening the rim should have effects closely corresponding to increasing the inflation pressure.

"As far as the tire is concerned, the major if not indeed the only discernible betterment of wide-base rims, is that of treadwear," Mr. Evans opined, classifying into advantages and disadvantages the various effects of rim-width change. Reporting on a recent test program undertaken to evaluate the several effects of the use of rims of various widths, he presented data that showed a 22% increase in treadwear by increasing the rim width from 65% to 80% of that of the tire, and using an inflation pressure lower by 2 lb per sq in. Quoting results of tests made to determine the effect on the steering control of the car, he showed how the tire's progressively higher stability and cornering power as its rim width is increased are reflected in the wander and other handling characteristics of the car.

Speaking of the disadvantages of wide-base rims, he brought out that, by stiffening the tire and reducing its deflectability, widening the rim causes a harder, harsher, or joltier ride unless the inflation pressure is decreased sufficiently to give an equivalent ride. He pointed out that this pressure differential, believed to be necessary from considerations of ride, partially offsets the treadwear and stability advantages of wider rims.

Development of Wide-Rim Tires for Passenger Cars – E. A. ROBERTS, Firestone Tire & Rubber Co.

THE wide-base-rim tire program recently presented to the motorcar industry is the result of an analysis made by Firestone engineers looking toward the ever-increasing demands made of present-day motor-car tires, Mr. Roberts explained. Two years of development work and testing, he added, have proved that these ideas and designs are beneficial and practical.

Reviewing the factors in passenger-car tire performance that offer the greatest opportunities for improvement, Mr. Roberts brought out that:

1. Greater horsepower and increased speed of cars, together with the development of better roads, have made *tread wear* the outstanding cause of removal of passenger-car tires.
2. Safety at increased speeds demands more car *stability,* and tires should contribute to the problem of greater safety at high speeds.

With these factors in mind, he reported, it was agreed that a

wider foundation for the tire, or a wider rim, offered the greatest possibilities of improvement.

Results of tests conducted on wide-rim tires announced by Mr. Roberts show that:

1. There is an average improvement of 20% in non-skid tread mileage, the increase ranging from 5% for easy driving conditions to 80% for tests at maximum speed under hard driving conditions.

2. Stability and cornering power increase with rim width – approximately in the same proportion.

3. The effect of increased stability is very evident in improved cross-wind handling, especially at high speed.

4. From 2 to 4 lb per sq in. reduction in tire pressure was found necessary with wide-rim tires to produce equivalent ride, equal harshness, thump, and so on.

DISCUSSION

Chairman Smith led off discussion with his prepared summary of the development as a whole from the standpoint of the automobile manufacturer. When it was first inaugurated, he declared, the program was indeed very enticing to the automotive industry. The improvements just mentioned, he pointed out, did not have to be proved completely by road tests because they were natural and logical deductions, after considering the change in the design of the tire. The big complaint from the automobile manufacturers and the major stumbling block to the program, he said, was the lack of time for the proper testing of the new design, as the proposal was made just prior to the release dates for the new models.

As testing proceeded, he declared, disadvantages began to appear: riding comfort was not as pleasing; road harshness, noises from cross-overs on concrete roads, and other vibrations produced by the contour of the road were much more pronounced; steering effort during parking was increased due to the larger area of tread in contact with the road. Furthermore, he continued, considerable damage to the rim flange occurred. In an attempt to approximate a result and obtain a better ride, longer mileage, and more carrying capacity, he announced that Packard made last summer what might be called a half-way change to the wide-base program. The Packard 6 last year incorporated a 4.50 rim with a 6.25-16 tire. This was changed to a 5.00 rim and the tire was changed to 6.50-15, he reported, explaining similar changes that were made on other Packard models. The result of this change, he declared, was a definite improvement. The wide-base tire-and-rim program is of such vital importance, he concluded, that the work should be continued not only by the tire companies, but by the automobile industry as a whole.

Tests made by Pontiac on 6.00 and 6.50 tires mounted on wide-base rims showed about a 6% increase in tread life over that obtained with conventional rims, A. E. Leach of that company reported. He explained that the air pressure was 2 lb per sq in. less in the wide-base tires to give the same ride.

Robert Schilling of General Motors emphasized the significance of the increases in stability and cornering power obtainable by wide-base rims, in terms of improved handling of the car.

Pointing out that the symposium so far had offered no explanation of why tires on wide-base rims give better treadwear, Dr. B. J. Lemon, U. S. Rubber Co., wondered whether the longer treadwear is due to less tread movement or to greater area of contact on the road. The explanation for the improvement in treadwear, Mr. Evans told Dr. Lemon, is the better cornering power and lower slip angle. Recalling tests on rims on rough roads in Texas, Dr. Lemon also pointed out that rims that show up well on smooth roads may give poor results on rough roads. Tests at Buick confirm all the advantages claimed by the tire companies for wide-base rims and tires, contributed J. H. Booth of that company, reporting an improvement of over 20% in treadwear.

(*Continued on page 33*)

Henry Ford Receives SAE Life Membership

The first man to hold the office of First Vice President of the SAE, Henry Ford was presented with Life Membership in the Society on January 8. SAE President Arthur Nutt made the presentation in behalf of the Society

Mr. Ford is a Founder Member of the SAE and received his Life Membership on the day following presentation of Life Memberships to six other Founder Members: David Ferguson, John G. Perrin, William P. Kennedy, Lt.-Col. Harry A. Knox, Arthur J. Moulton, and Joseph Tracy. Mr. Ferguson and Mr. Perrin were present in person to receive their Life Memberships at the 1941 Annual Meeting Business Session on Tuesday evening, January 7

N A T I O N A L

NATIONAL defense policies were illuminated by fresh facts spread before automotive engineers in a series of papers which touched vital preparedness issues on every day of the 1941 SAE Annual Meeting. And in many instances, the fresh facts gave clear indications of the probable character of defense policies still in process of being formalized.

Nearly every word spoken throughout the week had at least an indirect bearing on preparedness, but certain speakers devoted almost their entire presentations directly to this problem. Important among those in this latter group were the papers given by Major-Gen. E. B. Gregory, Quartermaster

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***The Development and the Employment of the Armored Force* – MAJOR-GEN. CHARLES L. SCOTT, Acting Chief of the Armored Force. (Ordnance Session . . . Col. H. W. Alden, *Chairman.*)**

Major-Gen. Charles L. Scott

GERMAN superiority in armored forces, Gen. Scott said, was due to the fact that procurement, supply and command were concentrated under one head and this head developed definite, straight-forward doctrines for the employment of this force. Working independently and in no way copying the Germans, Gen. Scott stated, the line of thought of the American Army for development and employment in battle of armored forces has been strikingly similar to that of the Germans. Therefore, the results achieved in the present war by the German Panzer Divisions were no surprise to American officers. "In fact," Gen. Scott said, "these successes merely proved to us that we had for years a proper conception of the organization, equipment and employment of armored forces as well as considerable sound experience in the use of small units."

Gen. Scott applauded the creation of the Armored Force as a separate unit on July 10, 1940, as one of the two most constructive and up-to-date steps taken by our War Department since the last War. (Creation of the GHQ Air Force was the other of these steps.) By this action all efforts were pointed to cohesive action under a single commander. Progress since last July has been marked, Gen. Scott showed.

On July 10, 1940, our Army had about 400 serviceable tanks, some of which were obsolescent, and 500 or 600 other armored vehicles; its Armored Force consisted of only about 1800 vehicles of all types. Since that time it has expanded about 350% – and as now projected this expansion will continue until the force totals 84,000 officers and enlisted men and about 20,000 vehicles— or a growth of 1200%.

Stressing the magnitude of the production task ahead, Gen. Scott recognized the necessity of immediately freezing equipment design to permit mass production to get under way. Good progress in mass production already has been made, he said, on scout cars, light tanks and half trucks, while three large manufacturing concerns are now being tooled up to produce the medium tank, quantity production being expected by Spring of 1941.

Describing the scope of an Armored Force, its possibilities and limitations, and its constituent parts, Gen. Scott sought to clear up popular confusion about the difference between a motorized unit and an armored unit. There is a vast difference, he showed. A motorized unit transports a part or maybe all of its supplies, its weapons and its personnel to the battlefield in trucks. There the unit dismounts and goes into action, most of its vehicles being sent to the rear. An armored unit, on the other hand, transports all of its personnel in armed and armored vehicles, most of which, such as tanks, are employed as weapons.

The modern armored unit, Gen. Scott pointed out, is employed as a spearhead directed at a soft and vital spot in the enemy's armor. When thrown forward into this vital spot, the sustained power behind the spearhead is the might of the normal troops of all arms.

An Armored Division in the U. S. Army, as described by Gen. Scott, consists of air and ground reconnaissance units; two main combat elements, the Brigade with its mobile hard-hitting tanks supported by artillery; and an infantry-artillery element for attack, defense, delay and security. Such a Division, he showed, embodies 11,000 men, 19,000 weapons, and 2500 vehicles – most of them armored – and constitutes the fastest, hardest-hitting ground combat unit in the U. S. Army today. The Armored Brigade, which constitutes the striking force of the whole division, he said, occupies 41 miles of road space and usually therefore marches in multiple columns.

***Motor Transportation in the National Defense Program* – MAJOR-GEN. E. B. GREGORY, Quartermaster General, U. S. Army. (Passenger-Car Session . . . J. C. Zeder, *Chairman.*)**

"OUR military motorization policy is definite – but remains flexible," Gen. Gregory said when he announced that the U. S. Army needs a little more than 250,000 vehicles for the Army of 1,400,000 men now being built. These vehicles are being bought only as rapidly as various troop units spring into being to need them. Today, Gen. Gregory said, we have about 60,000 vehicles; by March there will be about 100,000; by July, about 190,000. The remaining 60,000 vehicles will be delivered, he said, in the late summer and early fall of this year.

Following its established policy of limiting its orders so far as possible to models already in commercial production, necessary modifications to meet military needs have not delayed production materially, Gen. Gregory stated. When the total QMC fleet of 250,000 vehicles is completed, he revealed, it will consist of: 27,000 motorcycles; 4500 ¼-ton trucks; 5900 passenger cars; 3400 ambulances; 69,000 ½-ton trucks; 44,000 1½-ton trucks; 58,000 2½-ton trucks; 3800 4-ton trucks; 3800 6-ton and heavier trucks; and 37,800 2½-ton truck-tractors with one trailer each.

Gen. Gregory stressed the Army's belief that the all-wheel drive principle is essential for Army vehicles, and stated that in every case "the result of the all-wheel drive has been performance surpassing the expectation of the engineers. He mentioned the Army's need for a new ¼-ton reconnaissance truck-car combination for general utility purposes which would weigh about

DEFENSE

General, U. S. Army; Major-Gen. C. L. Scott, Acting Chief of the Armored Force, U. S. Army; Major-Gen. G. H. Brett, Chief, U. S. Army Air Corps (which was presented by Brig.-Gen. Oliver P. Echols in Gen. Brett's absence); Rear-Admiral J. H. Towers, Chief of the Bureau of Aeronautics, U. S. Navy; Gen. Hugh S. Johnson; B. B. Bachman, chairman, SAE National Defense Committee; and H. W. Gillett, Battelle Memorial Institute.

Summaries of these papers follow.

Rear-Admiral J. H. Towers T. P. Wright Brig.-Gen. O. P. Echols

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2000 lb. Several makers have produced such a vehicle, he said, and tests are now under way to determine its military value.

He praised automobile engineers for the progress made in conversion of truck types. By using a third driving-axle in a rear bogie arrangement, he said, it is possible to obtain from the light 1½-ton truck, a 2½-ton payload vehicle with many interchangeable parts. In this connection, however, he stressed two problems still awaiting solution: (1) to secure in peacetime such converted vehicles at a price which will permit motorization of the Army with needed all-wheel drives, and (2) to provide these vehicles in the number required to meet war needs without delay. "There is room for development of a peacetime use of 4-wheel drive vehicles of all sizes," Gen. Gregory said and urged the automotive engineers to give some thought to this problem.

Gen. Gregory paised the excellent job just completed by the SAE-QMAC Advisory Committee, said there is still much to do along standardization lines and concluded:

Major-Gen. E. B. Gregory

"Each of us has a job to do. All of us are vitally concerned with the speed and progress of every phase of our national defense program, but – most of all – let us have the best motor transportation system the world has ever seen."

***The Air Corps' Program in National Defense* – MAJOR-GEN. GEORGE H. BRETT, Chief of the Air Corps (Presented by BRIG.-GEN. OLIVER P. ECHOLS). (Aviation Session . . . T. P. Wright, *Chairman.*)**

"QUALITY in military aircraft must be maintained at all costs," Gen. Brett emphasized throughout his paper. "It is not a question of quality versus quantity, as many thoughtlessly believe," he pointed out, "rather there must be both quality and quantity." He explained that he did not use the term "quality" to indicate mere excellence or refinement of design and material, but to include those attributes and characteristics which make for maximum utility. The military airplane, he declared, is a weapon and its utility is therefore measured by its efficiency in war. The attributes which make for combat efficiency, he named as aerodynamic performance, offensive power, and defensive strength.

"Each one of these factors," he continued, "must be exploited to the *n*th degree if the maximum performance is to be obtained and if victory is to crown the heroic efforts of man and machine in the fury of combat in thin and freezing air six or seven miles above the earth at greater speeds than that of a bullet leaving a pistol.

"The temptation to make concessions in the matter of excellence of materials and design in order to speed production in these trying days is very great. But two compelling reasons forbid that we accept anything less than the best. The first is the obligation that we owe to those intrepid young flyers who risk their limbs and lives that this nation may live. The second is that our very safety as individuals and as a nation depends on maintaining this high standard of quality."

Time is required to produce adequate quantities of mechanized equipment, he declared, and quantity production is greatly expedited by standardization of the parts and materials. On the other hand, he averred, constant progress resulting from research and development is absolutely essential to keep the performance of our materiel abreast of that of our competitors. The problem of balancing our need for quantity against equal need for improvement, he revealed, is engrossing the most careful consideration of the Air Corps at the present time.

DISCUSSION

Answering a question from the floor, Gen. Echols delivered the *coup de grace* to current rumors that the planes that we are sending overseas are inferior to British ships. "Until last March," he reported, "we did not release our latest designs, and practically all U. S. airplanes in service abroad were purchased prior to this date." He explained that the Army did not like to let some of them go as it was known that they were obsolete, but they were finally released because of the pressure of the emergency. Referring to rumors that the British could not use our bombers for bombing and so are employing them for training and observation, he pointed out that these ships were built for the French and, therefore, cannot take the English bombs. He assured his audience that the planes now being sent to Britain are not inferior. Supplementing these remarks, Chairman Wright brought out that foreign governments sometimes compare the performance of their experimental planes with our service planes.

That there is no conflict between quality and production was stressed by Murray Fahnestock, *Ford Field Magazine*. Maintaining quality, he contended, is the best way to get production as it eliminates many service operations. To show that this country has led the way in quality as well as quantity production, he pointed to the fact that we were the first to develop interchangeability in production. Chairman Wright explained that the quality referred to by Gen. Brett is the quality of performance of aircraft as a fighting weapon – not the quality obtained by manufacturing refinements.

Although anti-aircraft fire has accounted for only a small percentage of the planes

brought down in the present war, Gen. Echols explained, it has kept raiding planes higher, disconcerting the pilots and spoiling their aim. Barrage balloons, such as those used above London, he believes, are fairly effective and make low flying dangerous, giving the raiding pilot one more thing to worry about. These barrage balloons, he told another questioner, are the only use which lighter-than-air craft still have from a military standpoint. He added that the Navy still has a few non-rigid airships.

***The Navy's Program in National Defense* – REAR-ADMIRAL J. H. TOWERS, Chief of Bureau of Aeronautics. (Aviation Session . . . T. P. Wright, *Chairman.*)**

THIS country is progressing in its aircraft defense program much better than the newspaper columnists would have us believe, Admiral Towers contended. "We are trying to do in two years what other nations took much longer to accomplish," he explained. The U. S. Navy, he announced, now has three types of radial aircooled aircraft engine of higher power than possessed by any other nation. This power (approximately 2000 hp), he declared, results in a speed of over 400 mph in Navy planes.

In spite of the amount of publicity given to the aircraft production program, which he called the "glamour girl" of defense, he revealed that the Navy ship-building program is larger than the combined aircraft programs of the Army and Navy. About 34 of the ships under construction, he reported, will be used solely for aircraft services.

Echoing the theme of Gen. Brett's paper read earlier at the same session, Admiral Towers emphasized that quality as well as quantity is vital. Two programs are necessary to deliver both quality and quantity, he contended – an immediate production program and a long-range development program – and both must be carried on simultaneously.

Concluding with a plea for greater speed and closer cooperation in the defense effort, he said: "We want you to know that the Navy is with you and for you in your efforts to help in this vast procurement program."

DISCUSSION

Asked to qualify his statement on liquid-cooled and aircooled aircraft engines, Admiral Towers declared that the highest powered American liquid-cooled engine now available is rated at about 1100 hp, whereas the highest-powered American radial aircooled engine is rated at from 1850 to 2000 hp. The way to get speed in aircraft is with power if the drag is kept low, he explained, adding that the drag of these radial aircooled engines is low enough so that higher speeds are obtained with them than with the lower-powered lower-drag liquid-cooled engines. "I believe and hope that we will be able to get liquid-cooled engines in the higher powers," he qualified, "but unfortunately they are not available at present."

Elaborating on his statement that "if we had a Navy several years ago two-thirds the size of the one that we are now building, there would be no war," in reply to a question by J. Webb Saffold, G. M. Saffold Engineering Laboratories, he explained that, in such a case, we would have had a Navy in both Atlantic and Pacific Oceans. He expressed his doubt that the tri-party agreement between Germany, Italy, and Japan would have been made under these conditions and, consequently, the war would have been avoided. The power of the combined American and British fleets in the Pacific compares with that of the Japanese fleet in the ratio of 5: 3¾ or 4, he told another questioner. He pointed out that the British have only isolated units in the Pacific, some of which are Australian.

In reply to other queries, Admiral Towers asserted that he knew of no effective defense for night bombing, although anti-aircraft barrages keep the raiders at a higher altitude. He added that, in night bombing, the flyers cannot see their objective – they merely see an area and, although it does a lot of damage and kills a lot of people, it is not very effective from a military standpoint. Power-operated gun turrets, he reported, are now in an advanced stage of experimentation in this country. "That the American bomb sight must be pretty good," he concluded, "is indicated by the number of countries that are trying to get it."

***The SAE's National Defense Program* – B. B. BACHMAN, Chairman, SAE National Defense Committee. (Passenger-Car Session . . . J. C. Zeder, *Chairman.*)**

SKETCHING briefly the fast-moving history of the SAE National Defense Committee and the already-completed phases of work accomplished by its divisions working with various branches of the U. S. Army and government, Mr. Bachman laid particular stress on the breadth of SAE scope and interest in the present emergency.

"It is not generally realized," he explained, "that the name Society of *Automotive* Engineers first came into being about 24 years ago, when the American Society of Aeronautical Engineers amalgamated with the Society of Automobile Engineers, the latter organization having been founded in 1905. But our present organization, the Society of Automotive Engineers, is definitely an organization in which automobile and aircraft engineers – as well as other engineering groups concerned with the internal combustion engine as a prime mover – are on an absolutely equal footing . . . and have been for 24 years.

"The results of this equality," Mr. Bachman stressed, "have been reflected in every phase of Society activity – in meetings, in the SAE Journal, in our transactions, in our research work – and in standardization activities. As far as standardization work is concerned, that equality has meant that standards effort by the Society has been carried forward in each field with the speed and scope demanded by the members representing each of the special interests."

Mr. Bachman summarized SAE national defense activity results, details of which have been reported in previous SAE Journal issues, paid tribute to "the men who have unselfishly and loyally contributed the time and the talent which has made accomplishment possible," and concluded by expressing his Committee's deep appreciation of the reception given its efforts by the officers and engineers of the Government departments.

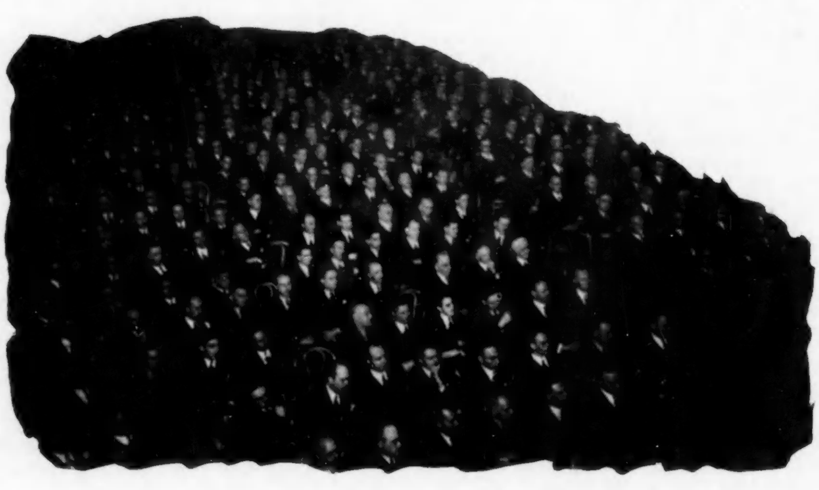
DISCUSSION

"The wholesale motorization of modern warfare has made it necessary for the engineer to take the initiative in the defense program because he alone possesses the knowledge and skill to adapt the internal combustion engine to military uses," J. C. Zeder, chief engineer, Chrysler Corp., said in opening the session at which Quartermaster-General E. B. Gregory and SAE National Defense Committee Chairman B. B. Bachman were the speakers. "There can be no doubt," Mr. Zeder continued, "that we, here in America, a nation born out of the ashes of tyranny and built on the rock of liberty, have the courage, brain power, and the indomitable spirit of our forefathers to hold our own against any onslaught that may be perpetrated by the villainous, power-mad dictators in the world today."

***Made in America Substitutes* – H. W. GILLETT, The Battelle Memorial Institute. (Junior-Student Session . . . A. C. Staley, *Chairman.*)**

UNITED STATES is more independent of outside sources for strategic materials than any other country – and its list of "have-nots" is much shorter than it was in the last World War. This was the cheering news brought by Dr. Gillett in his detailed analysis of just where we stand today as regards ersatz materials. He showed clearly, however, that very definite problems face the United States as regards manganese supplies and substitutes, that tin also is a major worry, and that the situation on chromium "is not so rosy."

Detailing our position in each of the ersatz categories, Dr. Gillett pointed out that high cards in the ersatz deck may be of several denominations. A "stock-pile" of materials is a high card, but not necessarily



K. T. Keller

a winning one. No one knows how long a war will last. More powerful cards are techniques capable of bringing into use low-grade domestic supplies and/or the creation or existence of domestically available substitutes. Domestically available resources of lower grade materials are only of potential, not actual, value, however, Dr. Gillett warned, "until there also exists the technical knowledge of how to use them and the special equipment for their processing." Then he added: "Seldom is the technology so developed ahead of the emergency that we know just what equipment to use." A *real* substitute, he stressed, is a thing we'd just as soon have at the same cost, and said that the rapid development of usable domestic substitutes must be based upon the results of research *already* done, on facts ready to be utilized.

The metals about which the United States is chiefly concerned, according to Dr. Gillett, are tungsten, antimony, chromium, tin and manganese.

In the case of tungsten, Dr. Gillett said, we have large stocks, active development of domestic mines, and a highly satisfactory substitute material – molybdenum. The 80% of tungsten consumption which goes into high-speed steel, Dr. Gillett said, is very largely replaceable by molybdenum.

Although the United States contains but little antimony ore, Dr. Gillett said, we have a usable made-in-America substitute (calcium) for the major use, which is in storage batteries; large existing stocks, and short hauls for importations.

Chromium, on the other hand, is cause for more concern. Demand is increasing and we have no obvious substitute. Development of new techniques permitting utilization of low-grade ores seems to be our best bet in the long run. Immediate worry is relieved by the presence of large stock-piles, especially those accumulated by provident private firms before the government began to stock imported chromium ore.

Tin is a real worry, according to Dr. Gillett. We have no domestic tin ore at all and what we now have is imported over long sea lanes. He concluded, however, that "if it were necessary, the United States could get along by making changes in technique that could be accomplished in a year or so, with no more than one-tenth of its present importation of tin – and stocks are now being accumulated to give the necessary time for such changes should the need arise."

With every short ton of steel requiring about 11 lb of manganese, with demand for steel tonnage increasing by leaps and bounds, and with the necessity for importing at least 2/3 of our manganese needs, the manganese situation, Dr. Gillett warned "cries aloud for a broad program of research on economical utilization of low-grade ores, not carried on, as much of the past research has been, with the idea of proving that someone's pet preconceived idea will be the answer, but with a completely open mind."

Stressing the need for broad research throughout the ersatz field, Dr. Gillett pointed to the fact that cheap materials like chromium and manganese do not create a natural urge for substitution in normal peacetime – yet such substitutes may be life-savers in time of stress. "This apathy," he concluded, "is not a forward-looking attitude. Research to find substitutes should be encouraged and something analogous to 'educational orders,' by which promising ones might get the benefit of actual use, even though for the present they cost a bit more, might well be substituted."

***National Defense* – GEN. HUGH S. JOHNSON. (Production Session . . . K. T. Keller, *Chairman;* E. R. Smith, *Technical Chairman.*)**

THE typical American method of war industrial mobilization, Gen. Johnson pointed out, depends upon three intangibles – absolute confidence of the Government control in industry; absolute confidence of industry in the Government control, and absolute willingness of the companies in each industry and the great industries together to substitute all-out cooperation for the all-out competition of peacetime economy.

"American industry must become a team," he went on, "with the Office for Production Management as its captain. It must give and expect the same loyalty toward that captain that he must give to it. The individual players must be as loyal in running interference for each other and selflessly doing their stuff against opposition as the best of the wonderful football teams of 1940. If all that isn't done, this great belated armament program isn't going to work. If it doesn't work, you and I and all of us who depend on the American organization of industry as we have known and loved it, might just as well empty the pot out of the window, whistle at the dog, and emigrate to Tahiti."

Gen. Johnson branded as "false, dumb and ghastly" common talk to the effect that industry isn't going to do this job unless we get into action somewhere and kill a few thousand Americans.

Industry must perform production miracles, Gen. Johnson warned, for if it fails, or even falters, one of the most sinister cries will be heard that ever echoed in America: "The capitalist system is no good. . . We gave it every opportunity but it failed. . . Now let the Government take over industry."

At the conclusion of his address, he delivered a message sent to the meeting by

Gen. Hugh S. Johnson

Mr. Knudsen: "Farm your stuff out until you have every skill and every machine in the industry continuously employed," Mr. Knudsen urged.

DISCUSSION

Official announcement that the Chrysler Corp. has contracted to produce parts for Martin bombers was made by Chairman Keller, Chrysler president, in an informal preliminary talk. He expressed confidence that his organization could turn out "torsos" for an additional 100 bombers a month as soon as they get tooled up for the job.

Charging that talk of automotive men revolutionizing the aircraft industry is "pure bunk," he advised automotive production men that their first duty is to acquire all the information possible from organizations experienced in making defense equipment. After that, he said, "you can put your own information on top of it." In the case of his own organization, he explained that "we will start in on the job just the way Martin wants us to."

Indicating that he expected to man the job fully from his own organization, Mr. Keller brought out that the energy and enthusiasm with which the men "down the line" in his organization are tackling new responsibilities speak well for American industry today.

In the first of many questions fired at Gen. Johnson from the floor, the columnist was asked to compare the Garand and Johnson rifles. He explained that they were both good rifles, but, in his opinion, the Johnson rifle was lighter and simpler. "Nevertheless, since the Garand rifle already is in production," he pointed out, "this is no time to go back and change our minds."

"Can the defense production job be done on a 40-hr week?" was the next question. In reply, Gen. Johnson emphasized that the important job was to keep machines operating 24 hr per day. The job can be done on the 40-hr week, he opined, by working three shifts a day until the unemployed are

absorbed, at which time, he believes, public opinion will demand that the working hours be lengthened.

Specifying 50,000 aircraft a year or 500 airplanes a day without mentioning the kind – whether they are small trainers or expensive bombers – he contended in answer to another query, "is like specifying so many boats without mentioning whether rowboats or battleships are desired." With all the forces that are now being set into action, however, he predicted that production will be large, provided that the number of design changes is kept down. Constant change, he charged, was the trouble with American plane production in 1917. At some time, he declared, someone must say: "Here is where design stops and production begins."

"Where are all these millions of unemployed?" asked another discusser, claiming that there is a definite shortage of skilled labor in the Detroit area. He suggested that many older men who had formerly been foremen, machinists and mechanics are now working at lesser jobs and who could be drafted into service. Maintaining that there were still plenty of skilled unemployed workers to be absorbed in other industrial sections, Gen. Johnson conceded that Detroit probably is an exception.

Asked what he thought of the proposal to standardize our arms with the British, he averred that we should depend "only on our own right arm" and not get tied up too closely with any other people. He added that, from a practical standpoint, both America and Britain have gone too far on their own designs to make standardization feasible. He conceded, however, that the question of field-artillery standardization was different, and that such a joint standardization might be possible in future plane designs.

Replying to other questions, Gen. Johnson opined that unwarranted strikes would decline because of public opinion; that the South American countries would continue to be friendly toward the United States as long as it is to their own best interests, but that their backgrounds, connections, and types of government were adverse to ours; and that one year of military training for every American boy when he becomes 18 or some nearby age would be desirable at a later date, but not in the present emergency.

SAE Coming Events

March 12 – 14	**National Aeronautic Meeting** **Washington Hotel – Washington, D. C.**
May 12 - 13	**National Production Meeting** **Schroeder Hotel – Milwaukee, Wis.**
June 1 – 6	**Summer Meeting** **The Greenbrier – White Sulphur Springs, W. Va.**
Sept. 25 – 26	**National Tractor Meeting** **Schroeder Hotel – Milwaukee, Wis.**
Oct. 30 – 31 & Nov. 1	**National Aircraft Production Meeting** **Biltmore Hotel – Los Angeles, Calif.**

Baltimore – Feb. 13

Engineers Club; dinner 6:30 p. m. Speaker – E. R. Fitch, chief engineer, Bendix Westinghouse Automotive Air Brake Co.

Buffalo – Feb. 12

Markeen Hotel; dinner 6:30 p. m. Plastics – H. S. Spencer, Durez Plastic and Chemical Co.

Canadian – Feb. 12

Royal York Hotel, Toronto; dinner 6:30 p. m. Behind the Scenes in National Defense Engineering – A. T. Colwell, vice president, Thompson Products, Inc., and president, SAE. Guest – John A. C. Warner, secretary and general manager, SAE.

Chicago – Feb. 4 & 25

Feb. 4 – Chicago Towers Club; dinner 6:45 p. m. Design Features Involved in the Development of Small Bore Tractor Diesels – C. G. A. Rosen, Caterpillar Tractor Co.

Feb. 25 – Chicago Towers Club; dinner 6:45 p. m. Behind the Scenes in National Defense Engineering – A. T. Colwell, vice president, Thompson Products, Inc., and president, SAE. Guest – John A. C. Warner, secretary and general manager, SAE.

Cleveland – Feb. 10

Cleveland Club; dinner 6:30 p. m. Submarines – Lt.-Com. Joseph P. Thew, U. S. N.

Detroit – Feb. 3 & 24

Feb. 3 – Statler Hotel; dinner 6:30 p.m. Art and Color in Body Design – H. Ledyard Towle, director of advertising and creative design, Pittsburgh Plate Glass Co.

Feb. 24 – Statler Hotel; meeting 8:00 p.m. Behind the Scenes in National Defense Engineering – A. T. Colwell, vice president, Thompson Products, Inc., and president, SAE. Guest – John A. C. Warner, secretary and general manager, SAE.

Indiana – Feb. 14

Gold Room, Hotel Antlers, Indianapolis; dinner 6:45 p.m. New Developments in Supercharged Diesels – H. L. Knudsen, chief engineer, Cummins Engine Co.

Kansas City – Feb. 26

Behind the Scenes in National Defense Engineering – A. T. Colwell, vice president, Thompson Products, Inc., and president, SAE. Guest – John A. C. Warner, secretary and general manager, SAE.

Metropolitan – Feb. 20

Hotel New Yorker, New York City; dinner 6:30 p. m. Cobwebs and Gasoline – F. C. Burk, supervisor, Automotive Laboratories, Atlantic Refining Co. N.A.C.A. high-speed motion pictures prepared by A. M. Rothrock.

Milwaukee – Feb. 14

Milwaukee Athletic Club; dinner 6:00 p.m. Relative Merits of Gas, Mechanical, Diesel-Electric, and Electric-Powered Buses – H. E. Simi, chief engineer, Twin Coach Co.

New England – Feb. 11

Speaker: Wilbur Shaw.

Northern California – Feb. 8

Fairmont Hotel, San Francisco. Annual Dinner Dance and Entertainment.

Northwest – Feb. 4

Hotel Gowman, Seattle. Mechanical Improvements in 1941 Automotive Vehicles – Wallace Linville, chief automotive engineer, General Petroleum Corp.

Oregon – Feb. 19

Lloyds Golf Club, Portland; dinner 6:30 p. m. Lubrication Requirements of Modern Automobiles – Wallace Linville, chief automotive engineer, General Petroleum Corp.

Philadelphia – Feb. 12

Penn Athletic Club. Subject: Transportation and Maintenance.

Pittsburgh – Feb. 25

Ladies' Night.

St. Louis – Feb. 25

Subject: Plastics.

Southern California – Feb. 11 & 21

Feb. 11 – Los Angeles. Truck, Bus and Railcar meeting.

Feb. 21 – Glendale. Subject: Aircraft Accessories.

Southern New England – Feb. 5

Hotel Bond, Hartford, Conn.; dinner 6:30 p. m. Spring Design – Mr. Bechstedt, Wallace Barnes Co.

Syracuse – Feb. 10

Onondaga Hotel, dinner 6:30 p. m. Behind the Scenes in National Defense Engineering – A. T. Colwell, vice president, Thompson Products, Inc., and president, SAE. Guest – John A. C. Warner, secretary and general manager, SAE.

Washington – Feb. 11

Garden House, Dodge Hotel; dinner 6:30 p.m.

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PRESIDENT for 1941

1941 SEES as president of the Society Archie Trescott Colwell, a graduate of the United States Military Academy at West Point who, after four years of Army service, started on an outstanding engineering career that has contributed materially to practically every field touched by SAE activities. He brings to the office of president a background peculiarly fitted to the Society's current problems – problems involving widespread application of technical skills to national defense products as well as to steady development of automotive engineering for stabilization of our peace-time economy. Mr. Colwell is vice president of Thompson Products, Inc.

His development work in important engine and chassis parts has brought him close to problems encountered in design and production of automobiles, tractors and aircraft, and in this work he has gained a personal acquaintanceship with a wide circle of men in these fields. He has an international reputation for accomplishments in improved heat-resistant valves and valve-seat inserts for high-duty automobile and aircraft engines.

He graduated from West Point in the class of Nov. 1, 1918, as the second ranking cadet officer, and while there was cited as a "distinguished cadet" in academic work. Then followed four years in the Corps of Engineers of the Army, during which he graduated from the Engineer School of the Army at Fort Humphreys, Va., and later received the degree of Bachelor of Science from the Military Academy. He was assistant professor of Military Science at Rose Polytechnic Institute, Terre Haute, Ind., and was active in the Officers' Reserve Corps and the Ohio National Guard. Pressure of business affairs compelled relinquishing these activities in recent years.

In 1922, upon leaving the Army, Mr. Colwell started as junior salesman with the Steel Products Co. When this company became Thompson Products, Inc., he remained with the organization. Promotions came rapidly and, by 1930, he had advanced through sales engineering posts to the position of director of engineering. He was elected a vice president of the company in 1937, and two years later became a member of the board of directors.

Each year, since he joined the SAE in 1930, Mr. Colwell has taken an increasingly active part in the accomplishments of the Society, serving on section and national administrative and technical committees. He was a Councilor in 1937 and 1938, and chairman of the Cleveland Section in 1936. He has presented a number of papers at section and national meetings, the most recent of which, "The Problem of Valve-Stem and Valve-Head Deposits," was published in the September 1940 issue of the SAE Journal. Mr Colwell has made three trips to Europe since 1935, the last one just before war was declared, and acquired a background on technical affairs there.

Mr. Colwell is a top-notch golfer. Among his trophies are those for the SAE championship in 1936 and for runner-up in 1938. He also is an expert pistol and rifle shot.

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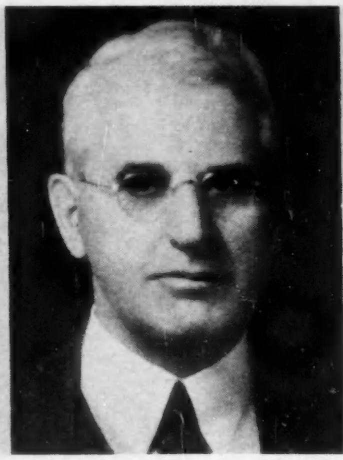


W. J. DAVIDSON (left), 1939 president of the Society, continues on the Council as past president. David Beecroft, Bendix Products Division, Bendix Aviation Corp. (center), will serve his ninth consecutive term as treasurer of the Society. Arthur Nutt, Wright Aeronautical Corp. (right), president of the Society for 1940, takes his place on the 1941 Council as past president

SAE COUNCILORS

N. C. Millman

AT present engaged in technical work for the Canadian Government's Department of National Defense, Councilor Millman's (M '27) industry post is product service manager, General Motors of Canada Ltd. Leave of absence will be arranged by the Dominion Government for Mr. Millman to attend Council Meetings. World War I changed the course of his career from designing transformer stations to automotive engineering. He served in the British Royal Air Force for three and a half years as a fighting pilot, test pilot, and instruction supervisor. In 1919 he entered the engineering department of Chevrolet in Canada, and has held increasingly important posts with GM of Canada ever since. Mr. Millman was educated at Ridley College and the University of Toronto, receiving his B.A. Sc. degree from the latter in 1913. He is a vice chairman of the SAE Canadian Section for the Oshawa District. ★ ★ ★

H. O. Mathews

COUNCILOR Mathews (M '31) served as chairman of the Chicago Section for 1939-40, and as vice president of the Society, representing the Transportation & Maintenance Activity in 1939. He is an alumnus of Purdue University, receiving his B.S.E.E. degree in 1923 and the professional degree of electrical engineer in 1927. Starting with the Bell Telephone System in 1923, he served in various capacities in the plant department until 1930. He then took charge of the automotive department in Chicago, with 500 trucks under his supervision. He left the Bell System in December 1936, to join the Public Utility Engineering & Service Corp. as automotive engineer. Mr. Mathews has presented a number of papers before the Society.

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D. A. Fales

TWO years after graduating from Massachusetts Institute of Technology with the Class of '15, Councilor Fales (M '19) was head of the aeronautical motor department of the U. S. Army School of Military Aeronautics and the seaplane motor department of the U. S. Naval Aviation Detachment at M.I.T. He had taught for a year as assistant instructor before organizing and directing these courses. After the War, he was advanced to the post of instructor in mechanical engineering. Leaving the Institute in 1920, he was Director of Education, U. S. Army Motor Transport Training Schools for two years. Returning to M.I.T., he took his present post as associate professor of automotive engineering and for ten years was a member of the instructing staff of the Army Ordnance School, conducted jointly by the Watertown Arsenal and M.I.T. He is a past chairman of the New England Section, and his analysis of new car models is one of the Section's annual features. Prof. Fales has a fondness for old cars, and is a stickler for safety in automobile design.

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CONTINUING on the SAE Council are (from left) Austin M. Wolf, automotive consultant; James B. Fisher, vice president, Waukesha Motor Co.; and Murray Fahnestock, editor of "Ford Field." These men are completing two-year terms to which they were elected last year

VICE PRESIDENTS

E. S. Chapman

Vice President Production Activity

EARLY last summer Mr. Chapman (M '36) was elected vice president in charge of production, of the Plymouth Corp., and assistant general manager of the company. He had been affiliated with the Chrysler organization for 12 years, beginning as master mechanic on the staff of K. T. Keller. Earlier, Mr. Chapman had been sales manager of the Gisholt Machine Co., a post attained after starting with the company as apprentice machinist in 1916. At the time he was promoted to the Plymouth vice presidency, Mr. Chapman was general works manager of the company.

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Dr. George W. Lewis

Vice President Aircraft-Engine Activity

VICE PRESIDENT LEWIS (M '18) has been director of aeronautical research, National Advisory Committee for Aeronautics, for almost 20 years. His accomplishments brought him the Daniel Guggenheim Medal in 1936 for "outstanding success in the direction of aeronautical research and for the development of original equipment and methods." Dr. Lewis earlier served as SAE vice president representing aircraft-engine engineering in 1931, and as Councilor in 1933 and 1934.

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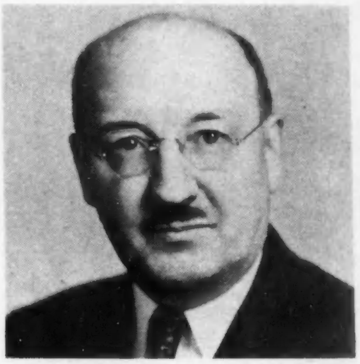
L. C. Lichty

Vice President Diesel-Engine Activity



IN 1918, soon after he had taken his first teaching post, at the University of Oklahoma, Prof. Lichty (M '27) was commissioned a lieutenant in the U. S. Air Service and placed in charge of the department of automotive transportation of the Air Service Mechanics School, Kelly Field, Texas. After the war, he was service manager for a branch of the Mercer Automobile Co. at Newark, N. J., later returning to the U. of Oklahoma faculty. His appointment as assistant professor at Yale University came in 1924, and his advance to associate professor of mechanical engineering in 1931. He holds B.S. in M.E., M.S. in M.E., and M.E. degrees from the University of Nebraska, the University of Illinois, and Yale University, respectively. Prof. Lichty has done extensive consulting work, published various papers dealing with automotive subjects, and is the author of several engineering books.

J. B. Macauley, Jr.

Vice President Fuels & Lubricants Activity

VICE PRESIDENT MACAULEY (M '24) is responsible for the direction of many of the research projects carried on by the Engineering Division of Chrysler Corp. During his 18 years with this corporation he has acted as chief engineer of the Chrysler Division and is at present head of the Power Plant Division in charge of experimental engine testing and development. His activities in problems mutual to the automotive and petroleum industries have included membership on many of the Society's Fuels & Lubricants Committees. Mr. Macauley's engineering course at the University of Illinois was terminated at the end of three years when he entered the U. S. Marine Corps, Flying Corps in 1917. After the War he worked at Packard and American Brake Shoe & Foundry Co., before joining Chrysler (then Maxwell).

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Karl M. Wise

Vice President Passenger-Car Activity

IN 1904 Vice President Wise (M '19) entered the automotive industry as draftsman with the Federal Manufacturing Co. in Cleveland. Then, followed positions with Wayne Automobile, which later became Studebaker, the Crucible Steel Co. of America, Chalmers, and the Detroit Testing Laboratories. In 1919 he was a member of the firm of American Engineering Associates. Returning to the Studebaker corporation in 1922, he became executive engineer in 1926 and in 1928 was made director of engineering for Pierce Arrow, holding that position until 1934. In that year he joined the Bendix Products Division of the Bendix Aviation Corp., of which he is director of engineering. Mr. Wise has served on a number of SAE committees and was vice chairman of the Buffalo Section for two years.

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J. R. Hughes

Vice President Passenger-Car-Body Activity

A COURSE in road carriage building taken at the City Technical School, Liverpool, England, started Vice President Hughes (M '32) toward his present post as chief body engineer for Studebaker. Born in England, Mr. Hughes became a citizen of the United States in 1924. At that time he was chief body engineer at the Ford Motor Co., with which he was affiliated for about 14 years before joining Studebaker. Since 1935 he has been a member of the SAE Passenger-Car Body Activity Committee, serving last year as its representative on the National Membership Committee.

Mac Short

Vice President Aircraft Activity

MR. SHORT (M '24) repeats as SAE vice president for Aircraft Engineering, previously having been elected to that post in 1936. He is vice president of engineering of the Vega Airplane Co. and was one of the founders of this subsidiary of Lockheed Aircraft Co. Prior to joining Vega in 1937, Mr. Short was for ten years vice president in charge of engineering of the Stearman Aircraft Co., which he helped to organize. Earlier, he had taught aeronautics at M.I.T., and served in a civilian engineering capacity at McCook Field, Air Corps Experimental Station. He started flying as an Air Corps pilot when the World War interrupted his college education. He later received his B.S. in M.E. degree from Kansas State College in 1922, and his M.S. in aeronautical engineering from M.I.T. in 1926. Mr. Short is vice chairman of the Southern California Section.

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Chauncey W. Smith

Vice President Tractor & Industrial Activity

TEACHING is the life work of Vice President Smith (M '27). He has been on the faculty of the University of Nebraska since 1918, specializing in the automotive aspects of rural engineering and actively participating in the University's famous Tractor Tests. He was advanced to professor of agricultural engineering, the post he now holds, in 1927. After receiving his B.S. degree at the U. of Nebraska in 1914, Prof. Smith taught at the Nebraska School of Agriculture and was Seward County, Neb., agricultural agent for a year, before he returned to his Alma Mater as a faculty member. He received his M.S. degree from the University of Chicago in 1922, and the degree of M.E., from the University of California in 1938. Last year Prof. Smith was vice chairman of the SAE Tractor & Industrial Activity Committee.

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T. L. Preble

Vice President Transportation & Maintenance Activity

VICE President Preble (M '26) graduated from the University of California just in time to get in one year of study at the Harvard Business School before entering the Army. He was commissioned a captain and sent to France where he gained further education at the French Army Motor Transport School, graduating in 1917. He continued with the A.E.F. until 1919, when he returned to this country and went to work as civilian department head of the Quartermaster Corps at Camp Holabird, Md. Then followed increasingly important sales and service posts with White Motor Co., Brockway, Pierce Arrow division of White, and General Motors Truck. In 1933, he took his present position with the Tide Water Associated Oil Co., as supervisor of automotive transportation. Mr. Preble was chairman of the SAE Metropolitan Section and is active on a number of the Society's technical and administrative committees.

Rodman S. Reed

Vice President Truck, Bus & Railcar Activity

VICE PRESIDENT REED (M '20) is one of the pioneers in the automotive industry. In 1900 he left the Straight Line Engine Co. to become draftsman for the H. H. Franklin Mfg. Co., where he stayed for eight years. He then entered the Chase Motor Truck Co. as machine shop foreman, advancing to superintendent in charge of plant and design. This led to the post of chief engineer with the Brockway Motor Truck Co. which he took in 1912 and has held ever since. Mr. Reed has been chairman and vice chairman of the Society's Syracuse Section, and active on several SAE technical committees.

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MILITARY MEN SPUR SAE TO DEFENSE PEAK

at 1941 Annual Meeting in Detroit

(*Continued from page 21*)

James E. Hale, Firestone Tire & Rubber Co., drew attention to the amount of compromising that has been done in tire-and-rim engineering. He pointed out that the 6.00 and 7.00 sizes now can be put on four different rims and that these rims have three different flanges. Referring to the prospect of adding wide-base rims to this list, he commented: "Fortunately, rubber and cotton are flexible." He explained that too many rim-flange designs for the same tire are likely to lead to bead trouble. Addressing the car engineers, he urged: "If you can look at the problem on the basis of fundamentals and gravitate toward one rim size for every size of tire, it would be a fine thing for all concerned."

Another compromise is necessary for the success of wide-base rims, Mr. Booth contributed – the compromise between stability and harshness. This, he declared, is another job for the tire engineer.

Answering a question from the floor, Mr. Roberts explained that the flanges of wide-base rims were narrowed to avoid striking the curb and to reduce unsprung weight.

W. S. James, Studebaker Corp., asked whether it is true that there is a tendency for dirt to collect under the flanges of wide-base rims. He was answered by Mr. Evans who reported that fast driving over crooked ruts would put dirt under any type of flange, and that wide-base rims collected no dirt under ordinary driving conditions.

Asked about the effect of wide-base rims on rolling resistance, Dr. Cadwell replied that there was no difference when the pressure was 2 lb per sq in. less than in conventional tires, but that, if the pressure were 6 lb per sq in. lower, the rolling resistance would be higher and hence the latter pressure reduction is not recommended. He pointed out, in answer to another question concerning the wide variation of tire pressures from those recommended by the car manufacturers in cars on the road, that, although the pressures vary, they average up about right and that the tire service organizations are making a serious effort to educate the public on the necessity for maintaining recommended pressures.

T. C. Smith, American Telephone & Telegraph Co., assumed, for example, the case of a fleet of several thousand trucks with trailers equipped with tires of the same size rims, the trailer tires of which, he explained, wear longer. He then asked whether a change to wide-base rims would be justified for this fleet on a strictly economic basis by balancing the improvement in tread wear against the cost of the change. In reply, Mr. Hale told him that the answer to his question would depend upon the conditions under which the fleet operates. He pointed out that speed is an important factor, explaining that the tests showing the greatest improvement in treadwear were made at high speeds in passenger cars.

***Properties of Some Synthetic Rubbers* – L. B. SEBRELL and R. P. DINSMORE, The Goodyear Tire & Rubber Co. (Presented by Mr. Sebrell)**

DIFFERENCES between representative synthetic rubbers and natural rubber, as revealed by various tests and X-ray analysis of tire tread and representative mechanical goods stocks, were described by the authors. No attempt is made, they announced, to bring out the best properties which may be obtained with individual rubbers. A new dynamic test for evaluating various synthetic rubbers in comparison with natural rubbers was described and comparative test values given.

Although synthetic rubbers possess elasticity and resilience, they differ considerably, said the authors, in molecular makeup and it ought not to be expected that they will process precisely as does natural rubber. Synthetic rubbers are similar only in certain superficial properties, they pointed out. Some show abrasion resistance superior to that of natural rubber, they continued, but in such properties as resistance to very low temperatures and tackiness they are sometimes quite deficient. "We should look upon synthetic rubber," they declared, "not as a material which can be universally substituted for the natural product, but as a material having special properties . . . which will give improved results as compared with natural rubber" under certain conditions. The study in this paper is limited, however, they qualified, to synthetic rubbers capable of vulcanization. "By far the most serious aspect of the successful use of these (synthetic) rubbers is their difficult processability," they averred.

For severe service in tire treads, certain synthetic rubbers were recommended by the authors who added that they cannot, at present, be expected to equal natural rubber. None of the synthetic rubbers, they said, is the equal of natural rubber in rebound. "Synthetic rubber," they declared, "cannot be substituted for natural rubber on a quantitative basis nor on an equal cost basis without examining carefully the physical properties which are to result from such a procedure." There are also encountered various difficulties in substituting synthetic rubber for natural rubber, they added. Typical compounding results for several vulcanizable synthetic rubbers in two different formulas were given, as were tabular data on dynamic tests.

DISCUSSION

A lively discussion followed the paper dealing with synthetic rubbers. Much of it supplemented the authors' statement that methods used in attaining a given result with synthetics often involve a different technique than for natural rubber. Dr. Waldo L. Semon, B. F. Goodrich Co., stated that it is quite remarkable so quickly to have attained with synthetic rubber results in some respects equal to those realized only after decades of development in natural rubber. Both types of materials are extremely versatile, he said, and can be made to give a wide range of properties by a variety of compounding and other expedients. In utilizing the synthetics, however, the engineer should first define the requirements carefully and leave it to the rubber technologist to work out compounds which will yield this result. The public, Dr. Semon continued, has been led to believe that synthetic can rapidly replace natural rubber if an emergency required it. This it cannot do at present, he said, because it is high in price and available as yet only in relatively small quantities.

Walter Fishleigh asked for a simple statement as to the raw materials needed, relative cost and present supply, to which Mr. Sebrell replied that some raw materials come from petroleum and styrene, but manufacture involves cracking and other chemical reactions before a substance similar to latex is secured. Thereafter, working is similar to that for rubber but involves many differences and difficulties which require time to overcome.

K. D. Smith of Goodrich said that 600,000 tons of natural rubber a year are used in this country, 75% of which goes into tires. At present only a few tons a day

of synthetic rubbers are made, with the price around 75¢ a pound as against about 20¢ for natural rubber. If synthetic production can be stepped up to 100 tons a day, a price of about 25¢ a pound can be realized. To do even this, however, the rubber industry must be supplied with outside capital. Present stocks of natural rubber on hand or in transit here might last 18 months, or be made to do so, but it would take some two years to reach sufficient synthetic production to replace them, even if an early start were made, with ample Government help.

Strategic Metals – ZAY JEFFRIES, General Electric Co.

AFTER quoting Dr. C. K. Leith's data on the world situation in minerals in 1930, Mr. Jeffries pointed out some differences between peacetime or competitive economies and wartime or Government-controlled economies, especially as they affect strategic metals. He named the seven strategic metals and gave figures on the consumption of each in 1939 and the percentage of each produced in the Western Hemisphere.

Axis powers, he said, lack raw materials from which industrial products are made. Neither abundance nor sufficiency can be achieved by conquering European nations. Parts of Africa are desperately needed. "Probably the Balkans are not the ultimate objective of the present war activity in the Near East."

At present, only seven metals are listed as "strategic" for the United States: antimony, chromium, manganese, mercury, nickel, tin, and tungsten. Nickel can be had in sufficient quantities from Canada. Mercury can be produced domestically, but there are no known tin deposits in this country. Tin can be had from Bolivia. Around 35 to 40% of tungsten requirements are now produced here and our entire requirements could be produced domestically.

Aluminum and vanadium are listed as "critical" metals. They are needed for national defense and are available domestically but soon may require distribution control in wartime.

Industrial strength is potential war strength but at present is not actual war strength. It is necessary to translate it accordingly. We must consciously divert much of our efforts from peace to war products; plan wisely and act swiftly, being fair to those assuming the responsibility of war production. Our great industrial organization must, above all, have confidence in the defense leadership.

Color Research and Its Relation to One Phase of the Automotive Industry – W. H. BECK, Sherwood Brothers, Inc.

IN viewing the hundreds of textile samples furnished to one company for the interior upholstery of passenger cars, it becomes evident that what is lacking is a proper color specification which would determine the tolerances to be allowed the dyer from a given standard, Mr. Beck averred in the introduction to his paper. This specification, he pointed out, must not increase the initial cost of the material nor the cost of servicing when duplicate matched upholstered materials are required for replacement in cars in the field; thus the problem resolves into determining a method for describing color tolerance differences, paying due respects to the economics of the job as a whole.

The object of his paper, Mr. Beck announced, is to present the various bases of color research and the writing of color specifications for possible future adoption as SAE Standards. He emphasized that color research has made great strides since 1931, with the establishment and adoption of the tri-stimulus coordinates for the specifying of any color by the International Commission of Illuminants.

Mr. Beck went on to detail the steps of this research work, which was accomplished through the cooperation of the members of the Inter-Society Color Council, emphasizing its application not only to creating tolerance specifications for automotive upholstery materials, but also to all problems pertaining to color encountered in the automotive-engineering field. He contended further that the methods prescribed in his paper can be adapted to any and all color problems found in the industrial field.

DISCUSSION

At the conclusion of his presentation, Mr. Beck showed colored motion pictures to illustrate the method of color measurement by means of a recording photo-electric spectrophotometer. Walter T. Fishleigh, consulting engineer, and E. F. Lowe, SAE assistant general manager, paid tribute to the value of Mr. Beck's work and expressed the appreciation of the Society for his efforts.

AIRCRAFT SESSIONS

Chairmen

Peter Altman **J. G. Lee**

The possibility of increasing the static longitudinal stability of two- and four-engined aircraft by rotating their propellers in opposite directions instead of in the same direction, was dangled before aircraft designers at the first Aircraft Session. A description of the M.I.T.-Wright Brothers wind tunnel, America's newest, was another feature of this program.

A new attack on the old problem of flutter by means of higher mathematics and motion pictures of airflow in a smoke tunnel were presented at the final session.

The M.I.T.-Wright Brothers Wind Tunnel and Its Operating Equipment – JOHN R. MARKHAM, associate professor of aeronautical engineering, Massachusetts Institute of Technology.

WITH the new M.I.T.-Wright Brothers wind tunnel and balance system, Prof. Markham explained, it is possible to obtain measurements very rapidly on a complete airplane model from which the coefficients for all six components can be plotted with a minimum of calculation. It is usually possible, he continued, to mount the model so that the point representing the center of gravity of the airplane is on the balance axis, a feature which increases the accuracy of the results and the simplicity of the calculations.

This balance system, he declared, was designed to fulfill the following general specifications: It had to be compact for the pressure-type tunnel in which it operates requires that the shell surrounding the test section be kept to a minimum diameter; it should be arranged so that measurements of all six components could be made remotely and that angular settings of the model in pitch and yaw could be made from a remote station. It was required further that each component be measured independently and totally so as to simplify and shorten the numerical calculations.

He explained that the test section was made an ellipse in order to obtain as large a span-wise dimension as possible for a given test-section area. It is then possible, he pointed out, without requiring extra power, to test a model with a larger span in an elliptical tunnel than in a tunnel of circular cross-section of the same area at the same speed. He added that the bottom section of the ellipse has been made flat to simplify the balance support and fairing installation.

DISCUSSION

First of a barrage of questions directed at Prof. Markham concerned the angle of diffusion between the propeller section and the adjoining section of the tunnel; it was put by Roger W. Griswold, S.O.S. Syndicate, Inc. In reply, Prof. Markham conceded that this angle was larger than desirable for maximum efficiency, and explained that it was necessary because of space limitations and cost considerations.

"Is 160 F the upper limit of the operating temperature of the tunnel because of the control equipment?" asked George Higgins, University of Detroit, noting that he had run into difficulties with small motors at high temperatures in his work. Prof. Markham answered that 160 F was approximately the upper temperature limit, but because of other control equipment than small motors with which he reported no trouble. To another query he contended that the balancing system is remarkably free from vibration for most conditions, so that runs can be repeated with accuracy. However, he conceded that there may be some shake at maximum lift with some models. "Incidentally," he added, "we measure lifts as high as 1500 lb and use all-metal wings for some models because we have found that the strength of the wood model is the limiting factor."

To a question by H. D. Hoekstra, Civil Aeronautics Ad-

Leaders from Every Automotive Field Were at the Dinner

1 – Col. H. W. Alden, Timken-Detroit Axle Co., and Brig.-Gen. G. M. Barnes, Office of the Chief of Ordnance, War Department

2 – T. P. Wright, Curtiss-Wright Corp., and Dr. G. W. Lewis, National Advisory Committee for Aeronautics

3 – C. F. Kettering, General Motors Corp., and George W. Mason, Nash-Kelvinator Corp.

4 – Irving B. Babcock, Yellow Truck & Coach Mfg. Co., Lt.-Col. M. V. Brunson, Office of Quartermaster General, U. S. Army, Lt.-Col. H. J. Lawes, Commanding Officer, Quartermaster Depot, Camp Holabird, and Robert Page, Autocar Co.

5 – Mac Short, Vega Airplane Co., and Frank W. Caldwell, United Aircraft Corp.

6 – B. E. Hutchinson, Chrysler Corp., and W. J. Davidson

ministration, on the adaptability of the wind tunnel to flutter models, Prof. Markham announced that design work is going ahead for a special support system for flutter models. The NACA has the same general type of a tunnel but much larger, and the cost of the M.I.T.-Wright Brothers tunnel to date is $217,000, he told W. J. King, General Electric Co.

Injecting the subject of the uses of wind tunnels and their relation to design into the discussion, Ralph H. Upson, consulting engineer, contended that testing complete models does not constitute their entire use as some people seem to think – that their application for basic research is also important and should not be neglected. To his question Prof. Markham replied that the wind tunnel was now being used 20 hr a day solely for defense work for the aircraft manufacturers, mostly on testing and checking of designs. He expressed the hope that the day would come soon when it could be used for pure research. Mr. Upson was also answered by Dr. N. B. Moore, Curtiss-Wright Corp., who emphasized the important role of the wind tunnel in designing the airplane, especially in problems of power-on and power-off stability. To back his point he named a number of airplane companies that are now building their own wind tunnels. When these tunnels are completed, he pointed out, they may free such tunnels as that at M.I.T. for pure research work.

Effect of Opposite-Rotating Propellers on Static Longitudinal Stability – C. W. SCOTT, N. B. MOORE, and L. B. RUMPH, St. Louis Airplane Division, Curtiss-Wright Corp. (Presented by Dr. Moore)

THE problem to be discussed, Dr. Moore announced, is whether, on a twin-engined ship, propellers should both rotate in the same direction or in opposite directions. If in opposite directions, should they swing up and out over the fuselage or down and in? He explained that virtually all American twin-engine ships had propellers rotating in the same direction (right-hand or clockwise), and that a change-over would involve the use of special reverse-direction engines and left-hand propellers.

The trend toward higher wing loadings, greater power, and cleaner planes, he pointed out, has increased the de-stabilizing effect with power; therefore opposite-rotating propellers were investigated as a possible means for increasing static longitudinal stability of aircraft.

Wind-tunnel tests made by Seifert in Germany, he reported, indicated that improvement in power-on static longitudinal stability could be expected on a conventional twin-engine airplane by using opposite-rotating propellers that swing up and out, as compared with the usual case of right-hand propellers on both engines, and that opposite-rotating propellers swinging down and in would give less stability than the usual arrangement.

Preliminary tests in the 10-ft wind tunnel at the Guggenheim Aeronautics Laboratory of the California Institute of Technology, on a powered model of the Curtiss-Wright transport airplane, he continued, showed results just the reverse of Seifert's. Presenting results of these tests and some made by other companies, Dr. Moore brought out that the effect of opposite-rotating propellers on static longitudinal stability depends upon the lift coefficient and on the design of the aircraft itself.

He emphasized that the data do not at present allow the drawing of a definite conclusion which would aid in *predicting* the effect of opposite-rotating propellers on longitudinal stability.

"They do, however," he concluded, "support the belief of the authors that there is need for a fundamental study, both theoretical and experimental, of the effects on power-on static longitudinal stability. A determination of all the parameters involved and an evaluation of their effects both singly and collectively would furnish concepts of the basic mechanisms involved which might facilitate prediction of the effects. A few of the specific effects needing attention are:

"(1) The effect of nacelle location relative to the wing.

"(2) The effect of tail location relative to both wing and thrust line.

"(3) Determination of the quantitative effect of rotational components of the slipstream.

"(4) Complete survey, both theoretical and experimental, into the slipstream velocities at tail positions, and effect of the slipstream in changing the downwash at the tail."

DISCUSSION

To show that the idea of opposite-rotating propellers is not new, G. B. Patterson, Socony-Vacuum Oil Co., Inc., recalled that the first twin-engined airplane bought by the U. S. Government in 1916 for service in Mexico had opposite-rotating propellers. In answer to a question by J. G. Lee, United Aircraft Corp., Dr. Moore explained that use of a model constant-speed propeller would not be justified in this type of work. Replying to Mr. Upson as to the effect on lateral stability when the airplane is pitching and the tail plane is in different positions with respect to the slipstream, Dr. Moore declared that, for stability, the tail should either be completely in the slipstream or completely out of it, and that he does not believe that changes in lateral stability with opposite-rotating propellers are sufficient to be of importance. The stability is greatest with the tail all in the slipstream, he told Mr. Lee.

R. D. Kelly, United Air Lines Transport Corp., emphasized that opposite-rotating propellers would complicate maintenance and service problems of the airlines since the engine and propeller types would be doubled. He added, however, that this arrangement of propellers would be of interest to the airlines if it showed promise of improving the loading problem.

Called on to report what the NACA was doing on the problem, H. J. E. Reid, of that organization announced that a program of research on opposite-rotating propellers on two, four, and six-engined aircraft has been started, but that the work had been curtailed because of national-defense projects.

The need for a factor of safety in static longitudinal stability to take care of critical conditions was emphasized by W. C. Rockefeller, Vultee Aircraft Corp. Such a critical condition, he pointed out, occurs when it becomes necessary to apply power when approaching for a landing. Another critical point, contributed Dr. Moore, occurs when a twin-engined plane is forced to travel on one engine.

Outline of a General Approach to the Flutter Problem – S. J. LORING, Vought-Sikorsky Aircraft Division, United Aircraft Corp.

THE recent spectacular vibration of the Tacoma Narrows Suspension Bridge which eventually caused its failure and the "galloping" of sleet-laden electrical transmission wires are examples of flutter in fields other than aircraft, Mr. Loring revealed. He defined flutter as a "self-excited or unstable oscillation arising out of the simultaneous action of elastic, inertia, and aerodynamic 'lift' forces upon a mass, or a system of masses."

Mr. Loring emphasized that flutter is an increasingly important factor in aircraft design because of the trend toward higher speeds and the use of the more flexible structures which result from cutouts for access, visibility, or equipment. The purpose of his paper, he announced early in his presentation, is "to outline a general approach to the flutter problem through the use of some well-known principles and relations of dynamics, with the hope that this approach will lead eventually to methods of flutter analysis which will be as straightforward and dependable as are the methods of structural analysis at present." A possible line of development in this direction was suggested by Mr. Loring.

The new developments presented, he explained, are based on Lagrange's equations of motion and the connected concept of generalized coordinates, and make use of matrix rotation. Arguments and derivations, he continued, have been made as general as possible so that they may be applied to any problem. For clarity, an example of the application of the general methods to a particular structure is included for each step of the derivations. Mr. Loring analyzed the problem of flutter under headings of: "Specification of Displacements," "Lagrange's Equations of Motion," "Inertia Forces," "Elastic Forces," "Equations of Motion with No Air Forces," "Air Forces," and "Solutions of Equations of Motion with Air Forces Included."

DISCUSSION

H. D. Hoekstra, Civil Aeronautics Administration, opened discussion of Mr. Loring's paper by reading from prepared comments. He contended that, although the complicated character of aircraft flutter necessitates higher mathematics for an adequate study, great care must be taken in determining the required parameters in order to justify the method. He then outlined "what appears to be a sound overall attack on the flutter problem: (1) adequate ground vibration equipment; (2) procurement of flight vibration-measuring equipment; (3) comprehensive recording of frequencies and other physical parameters; and (4) preparation of readily usable charts, either theoretical or empirical, for use by designers."

In reply, Mr. Loring averred that, although actual measurement of vibration tends to check theory, the entire analysis can be done theoretically.

In written discussion read by Chairman Lee, Newman A. Hall drew attention to several questions raised by Mr. Loring's paper and "admittedly left unanswered." The proper choice of generalized coordinates in any extensive use of this theory, he believes, is a problem of the first rank. Will the theory be able to serve as a guide in this or will independent methods of investigation be required? he asked. He pointed out that the question of dynamic coupling also was passed over, which, he believes, may prove important in the cumulative effect of small factors. It probably will be possible, he concluded, to adjust the theory to correlate with further experimental and theoretical results on the nature of air forces. However, he added, how far is the usefulness of the theory dependent upon the knowledge of these forces?

Visualized Airflow – ROGER W. GRISWOLD II, Aerodynamic Consultant.

AIRFLOW pictures, both stills and movies, comprised the major part of Mr. Griswold's presentation. Before presenting the pictures, he described the "Whipoorwill" smoke tunnel used for making them:

The tunnel is of the non-return-flow type, he explained, which design is dictated by the need for continuous supply of fresh air when smoke lines are injected into the flow. The test area, which is spanned by the model so as to give two-dimensional flow, has a high narrow rectangular cross-section, he continued. A heavy plate glass window is mounted flush with the internal surface in the front face of the tunnel to expose the model to view, together with a field of 25 streamlines. Photoflood lamps sunk in the top and bottom tunnel walls provide an effective method of indirect lighting which brilliantly illuminates the flow for direct visual observation and is satisfactory for ordinary photographic results.

The powerplant, he went on, consists of a centrifugal blower belt-driven from an internal-combustion engine, with which combination air speeds up to 80 mph can be attained although the usual operating speed for visual flow investigation is 40 mph. Exhaust heat from this engine is utilized to activate the smoke-supply apparatus. This apparatus consists of a closed stove containing a heater unit through which the engine exhaust gases pass prior to a common discharge with the smoke-filled blower exhaust outside the building. Smoke is generated by smouldering rotten wood in this special-type stove.

With this equipment, Mr. Griswold concluded, and with a little care and thought in laying out the model, it is usually possible to provide for a variety of changes and modifications, the principal flow characteristics of which can be explored in a fraction of the time (and thus expense) and, in certain elemental respects, more thoroughly than is normally the case for the less-flexible three-dimensional quantitative tests. This tunnel is by no means a substitute for the latter equipment, he qualified, but it already has proved to be a useful and convenient piece of supplemental equipment for preliminary and exploratory flow research concerned with aerodynamic problems susceptible to two-dimensional investigation.

DISCUSSION

After congratulating Mr. Griswold for "the excellent pictures and photography," H. J. E. Reid, National Advisory Committee for Aeronautics, plied him with questions to find out more about how he got his results. Were any pictures taken at speeds as high as 80 mph; have you had any trouble with flow due to pulsations or fluctuations in the blower; what have you done to isolate vibrations from the tunnel; have you had any difficulties due to leakage; how do you get the rotten wood that you burn? he catechized. Mr. Griswold replied that the highest speed at which pictures have been taken is about 73 mph and that pulsation in the blower, leakage, or vibration had so far presented no difficulties. Concerning the fuel used to produce the smoke, he reported that they first tried fireworks but found that they left deposits and were too expensive. Kerosene next was tried, he continued, but the fire hazard of this fuel proved too great due to the condensation. The idea of using rotten wood, he reported, came from Germany. Rotten wood is used, he explained, because it has less moisture in it.

A question by Mr. Loring on the relative effects of rounded and sharp trailing edges of airfoils precipitated a lively discussion. Mr. Rockefeller contributed an experience in which an unstable aileron stick force was made stable simply by rounding off the sharp trailing edge. This change in the trailing edge, he explained, produced no noticeable effect on the lift and drag. On the contrary, Dr. Moore reported a wind-tunnel test in which the last 1/4 in. of the trailing edge of the airfoil was chipped off accidentally, with the result that the drag was practically doubled. He speculated on the effect on drag of the 2-in. radius used on the trailing edges of large aircraft.

AIRCRAFT-ENGINE SESSIONS

Chairmen

N. N. Tilley — **Robert Insley**

Questions flew thick and fast following presentation of papers at two packed Aircraft-Engine Sessions. Papers were heard on a new high-altitude fuel system; cylinder paints that not only protect the cylinders but assist in cooling; a survey of aircraft-engine testing; a new engine-testing development; and how to design more accurate diaphragm indicators of explosion pressures.

New High-Altitude Fuel System for Aircraft – W. H. CURTIS and R. R. CURTIS, Thompson Products, Inc. (Presented by W. H. Curtis)

THE Thompson Booster system, "the latest answer to the problem of adapting fuel systems to high-altitude flight," was introduced by the authors. They explained that this system was evolved as the result of the application of analytical reasoning to the systems that preceded it. In a brief description they brought out that the booster unit is a modified centrifugal pump attached directly to the fuel tank and driven by an electric motor; that the function of this booster unit is to prevent entrance of released vapor and air to the fuel line leading to the fuel pump on the engine; and that it also maintains sufficient pressure in this line to prevent additional release of air or vapor.

In a discussion of the physical behavior of aviation fuel at high altitude, supported by the results of laboratory tests, they declared that the basis is a fuel that is considered to be a stable solution of air and fixed gases in a liquid that is composed of a chain of hydrocarbons, one of which boils, under sea-level pressure, at 90 to 105 F. They went on to describe observed behavior of fuel systems in laboratory altitude simulations and to point out differences between this behavior and the apparent behavior during actual flight. Due to these differences, they explained, no direct correlation between laboratory simulations and actual flight performance can be made at the present time. "Until this handicap is overcome with continued re-

search," they concluded, "prediction of fuel-system performances must be based on comparisons between simulation tests."

The authors also summarized the work that has been done in the past on aircraft fuel systems to adapt them for high-altitude flight, giving the reasons for the failures that developed.

DISCUSSION

The need for two pumps in the new high-altitude fuel system described by Mr. Curtis was questioned by W. J. King, General Electric Co., who suggested that the booster pump could do the whole job. He cited examples of systems used for domestic oil burners that employ a single pump with enough capacity to take care of both the air and the fuel.

In reply, Mr. Curtis explained that two pumps are necessary because of safety as operators objected to "hanging the fuel system on the electrical system of the aircraft." He agreed that the booster pump can be made to do the entire job alone, and has done so at low altitudes. He emphasized the advantage of eliminating the hand pump in the new system, bringing out that the operator no longer can operate the hand pump and the aircraft simultaneously. A single pump to take care of both the fuel and the air, he contended, would be so large as to be prohibitive.

To another questioner Mr. Curtis pointed out that the centrifugal booster pump would not be satisfactory as a substitute for the conventional engine fuel pump for low-pressure systems (5 to 6 lb per sq in.) without some form of regulating valve.

Aircraft Cylinder Finishes – MYRON A. COLER, technical director, Engineering Products Division, Paragon Paint & Varnish Corp.

THAT certain enamels will improve the cooling characteristics of hot metal surfaces such as aircooled engine cylinders, is one of the important conclusions reported by Dr. Coler. Earlier in his talk he brought out that, at present, the chief purpose of a cylinder finish is to protect the underlying metal from corrosion. Good appearance, he added, is usually a secondary but important requirement. He pointed out that the question as to whether or not a coat of enamel will hinder the transfer of heat from a hot engine surface to the surrounding air still appears to be a moot one.

Other conclusions revealed by Dr. Coler as a result of an investigation aimed at finding an answer to this debated point are: 1. That the application of enamel to a cylinder surface seems to result in a lowering of the surface temperature, the magnitude of the difference increasing with increasing temperature; 2. That there is a definite improvement in the 500 F cooling efficiency with increasing numbers of coats of enamel so that cooling-rate increases in excess of 20% may be realized; 3. That cooling efficiencies appear to be almost independent of the nature of the base metal.

A deep-black high-gloss enamel cylinder finish was used in his tests, the author explained – applied in spray coats having an average thickness of the order of one or two mils. This particular product, he added, has been used extensively in manufacturing and field service work so that its application and performance characteristics are known to be satisfactory.

DISCUSSION

The relative effects on heat transfer of paints and finishes are markedly affected by the geometry of the surface, contended Mr. King, giving as examples a plain cylindrical surface and the cut-up surface of an airplane cylinder. This factor, in turn, he continued, affects the amount of heat dissipated by convection. There is a great deal of misconception, he declared, on the effect of color and emissivity at low temperatures. He cited an example of where the loss by radiation was increased by adding a layer of insulation to low-temperature copper pipes, since the insulation increased the radiating area and its emissivity was greater than that of the copper. Expressing his agreement, Dr. Coler declared that it is well to point out that the data on emissivity are "in bad shape as a whole." He reported that the problem of surface configuration is receiving full consideration by the NACA.

Questioned as to the feasibility of obtaining a satisfactory finish for use on the inside of cylinder cooling jackets of automobile engines to eliminate rust and corrosion, Dr. Coler replied that the problem is to get a finish that will stay on and still resist the solvent action of anti-freeze compounds. He expressed his belief that, if the demand were sufficiently great, a finish could be worked out for a reasonable range of anti-freeze compounds that also would aid in the transfer of heat from the engine cylinders to the cooling water.

Modern Aircraft-Engine Testing – W. D. GOVE, Pratt & Whitney Aircraft Division, United Aircraft Corp.

THE cost of fuel for testing large aircraft engines of 2000 hp and more is sufficient, Mr. Gove pointed out, to justify additional investment in testing equipment if the energy developed can be utilized for plant operations. These factors, he declared, point to the use of regenerative test stands when engines of over 2000 hp are to be tested in quantity production. He went on to describe a regenerative system in which the aircraft engine is hooked up to an a-c synchronous generator through a hydraulic coupling, the generator being connected electrically to the plant's electrical supply line.

Mr. Gove then reviewed the major items of test buildings and equipment for both new engine development laboratories and for the testing of production engines. He asserted that the rigid and involved testing requirements for present-day high-output aircraft engines have created many new problems in the line of testing equipment. Some of the detail equipment used for the development of such component parts of the engine as cylinders and pistons, superchargers, carburetors, and reduction gears, as well as of vibration equipment or parts thereof, were dealt with. He discussed stands for initial and acceptance testing of production engines, including motoring stands, propeller loading stands, absorption dynamometers, and the relatively new regenerative stands. Detailed test stand instruments and equipment were commented on. Mr. Gove discussed some aspects of the noise problems associated with aircraft-engine testing, and listed the hazards of this activity.

DISCUSSION

Supplementary information on the details of the testing equipment described in his paper was given by Mr. Gove in answer to a number of questions from the floor. Asked whether he had considered reclaiming the gasoline in the air around the carburetor test bench by condensation, he replied that he had, but that his studies indicated that the necessary reclaiming equipment would be too expensive as compared with the value of the gasoline to be reclaimed. To another questioner he explained that oil is added and taken away from the hydraulic coupling in the regenerative system by pumping it in or out of the oil cooler in the oil-circulation and scoop-tube system of the hydraulic coupling. Short exhaust stacks are used on engine test stands, he told another interrogator, so that the exhaust can be inspected. Discussing the design of engine test stands with vertical inlets and exhausts, he pointed out that the horizontal passage ahead of the propeller should be as long as practicable – at least one propeller diameter. He expressed his agreement with one discusser who pointed out that, unless the density of the air across the passages is constant, testing difficulties will result.

The Vultee Powerplant Tunnel – A New Testing Development – W. C. ROCKEFELLER, chief of aerodynamics, Vultee Aircraft, Inc.

ONE reason why the problem of cooling in flight has become of serious importance during the recent rapid advance in the development of new aircraft, Mr. Rockefeller explained early in his talk, is that the proper compromise must be made between drag for high speed and cooling under the most extreme conditions of flight. Because of the importance of this factor to performance, he pointed out

that this compromise is necessarily so close that difficulties are often encountered in the flight tests of the finished article.

In order to minimize these difficulties with the minimum sacrifice in the efficiencies of the powerplant unit, he announced that a new testing device, namely, the powerplant wind tunnel, is in the process of development at Vultee Aircraft, Inc. This testing unit, he explained, provides for the installation of the actual full-scale powerplant section of the airplane operating at tunnel airspeeds approaching as closely as practical the climbing airspeed of the airplane. Extensive testing and measuring equipment is provided, he said, so that the characteristics of the unit can be analyzed more in detail than is possible in flight.

In the remainder of his presentation, Mr. Rockefeller gave details of the equipment; explained the technique of operation; and presented preliminary test results obtained therefrom.

DISCUSSION

Further clarifying the purpose of the testing equipment for one discusser, Mr. Rockefeller explained that fitting the engine to each model built by his company is quite a problem and may mean complete change in cowl design. Then, also, he continued, the conditions under which two aircraft of the same design are called upon to operate may be entirely different; furthermore, the equipment is used to try out new devices. To another query, he replied that the engine support is not adjustable in yaw.

"We have an automatic recording device under development," he told another questioner, "that will take 100 temperatures in about 10 sec. Now it keeps three men busy taking the temperature-time data for the equipment." He went on to explain that photographing the thermometers simultaneously had first been considered, but that the disadvantage of this method is that the test operators cannot see all results at the time of operation because of the time necessary to develop and print the pictures. "The device that we are developing," he added, "will plot out the results continuously."

Some Factors Influencing the Performance of Diaphragm Indicators of Explosion Pressures – FRANK R. CALDWELL and ERNEST R. FIOCK, National Bureau of Standards. (Presented by Dr. Fiock)

MEASURED values of explosion pressure need not deviate from the truth by more than a few tenths of a millimeter of mercury with a properly designed diaphragm-type indicator, Messrs. Caldwell and Fiock concluded, following their presentation of the results of a comprehensive investigation of diaphragm indicators with the objective of making them more accurate and reliable over a wide range of conditions. They presented information obtained during the development and use of accurate diaphragm-type indicators of the pressures developed during explosions of gaseous mixtures in bombs. New experimental evidence, they declared, supports all the following conclusions and design recommendations:

"All passages and cavities on the explosion side of the diaphragm should be eliminated for highest accuracy. While the sensitivity of the diaphragm to pressure difference must not be less than the value determined by the accuracy with which pressures are to be measured, it cannot greatly exceed this same value lest the inertia error become larger than the allowable tolerance. Radial tension in the diaphragm is advantageous in reducing time lag. A blued or polished surface is preferable to one which absorbs more radiant energy. Projections around the diaphragms are without measurable effect upon performance of the indicators."

It seems probable, they stated, that the effects of accidental errors in the single observations can be decreased to some extent by smoothing operations applied to the radius-pressure data. Among the systematic errors, they continued, that resulting from inertia of the diaphragms is probably in the direction of low observed pressures, and that due to lag in the recording circuits is certainly in the same direction. However, that resulting from the absorption of radiant energy by the diaphragms is in the opposite direction. All things considered, the authors believe that there is small chance that the final, smoothed pressure relations deviate from the truth by more than a few tenths of a millimeter of mercury at any stage of the burning for which results were presented.

DIESEL-ENGINE SESSIONS

Chairmen

L. C. Lichty **C. G. A. Rosen**

Two diesel engine sessions ran the gamut from instrumentation problems relating to research for the future to immediate Navy needs for diesels in national defense. Discussion was active at both sessions.

Diesel Engines for the Navy – LT.-COM. M. M. DANA, U. S. Navy

COM. DANA commented that the Navy thoroughly appreciates the diesel engine and "has ambitious projects for its wider application in the future." He noted, however, that the present emergency is making severe demands upon the present sources of supply.

In recounting the Navy's general requirements for diesel engines, Com. Dana stressed: excellence of mechanical construction, of combustion, of means for the supply of combustion air, as well as light weight and compactness. He defined the basis for rating engines and gave shop test requirements. He also presented the rating diagram, on which each engine is completely defined as to basis of rating: – BMEP, specific volume, and rpm. The weight and space diagram, giving weight and prismatic coefficients on the basis of speed factor as defined for a number of modern diesel engines now in use in the Navy, was also shown.

Com. Dana concluded his paper with data on Naval requirements for diesels, including detail as to mechanical construction, torsional vibration, noise, and fuel consumption.

DISCUSSION

Structure of the diesel engine to withstand the loads and stresses resulting from bomb and mine explosions was the center of discussion of Com. Dana's paper. The author noted that the Navy from the beginning of the present era has insisted on welded-steel construction for the engine frame. C. L. Cummins, Cummins Engine Co., commented on the difficulty of finding men experienced in the welded-steel construction field. He also pointed out that accessory equipment must be designed to withstand the shock-loads and said specifically that this demand might lead to air or inertia starting.

P. B. Jackson, Aluminum Co. of America, stated that he could not agree that welded steel structure is the only best solution of damage done by bombs and mines. "I have seen numerous really beautiful welded-steel diesel-engine frames," he said, "but they weigh 80% to 100% more than aluminum castings for exactly the same operation. These steel structures have many die forgings and I don't believe die makers work any faster than pattern makers. I do not mean to imply that welded-steel structures should be replaced by castings – but I do feel that, where weight, cost, and availability are factors, aluminum castings should be given just consideration." He also argued that aluminum, due to its low modulus of elasticity, has ability to absorb shock – and that many shock-loading problems can be handled by design.

That comparison on a broad scale is somewhat misleading, was brought out by E. V. Rippingille, Research Laboratories Division, General Motors Corp. He observed that steel is cheaper than aluminum and, in the present emergency, more easily available. This, he feels, will lead to improvements in design of welded-steel structures. Mr. Rippingille further commented that we need something to stick aluminum together and that while aluminum welding is being perfected "riveted aluminum is what is carrying

the passengers." He urged: "Let us be open-minded, do the best job we can do today, and don't give up our research."

Hans Bohuslav, Enterprise Engine Co., observed that when well away from land and a welded-steel structure is broken, repairs can be made with a welding torch. Repairs would be much more difficult with cast-aluminum or cast-iron structures, he pointed out.

Superchargers were labeled by Lee Oldfield, consultant, as a "live subject." If better superchargers aren't available – and soon – he stated, it will be a reflection on the engineers. Mr. Bohuslav, speaking of the Bucci type, said that the output of the engine is not limited by pressure from the supercharger but by temperature of the exhaust turbine. This temperature, he added, can be reduced by changes in design.

Commenting on horsepower rating, O. D. Treiber, Diesel Division, Hercules Motors Corp., said that while bases have been established for altitude (sea level) and temperature (60 F) none have been established for humidity. He urged that this be done.

The Status of the Automotive Diesel – EUGENE H. FEZANDIE, associate professor, department of mechanical engineering, Stevens Institute of Technology.

INCREASED adoption of the automotive diesel in many fields was predicted by Prof. Fezandie. He commented that all the general classes of design will probably share in this increase, although some of them are more likely to establish themselves in such fields as may dictate, by their requirements, special compromises between economy, ruggedness, smoothness of performance, light weight, reliability, cost, and other factors.

Lower specific weights will be obtained for all classes, he said, through special materials and reduction of overall dimensions for a given power. In the case of the open-chamber type diesel, he added, it is expected that no large increases of speed are likely and that the best opportunity for weight reduction will be in the 2-cycle performance. For the ante-chamber, turbulence-chamber, air-cell, and energy-cell types, he believes that the best chances to obtain weight reduction will be in supercharging and moderate speed increases.

Improvement in combustion control and economy with existing fuels, Prof. Fezandie commented, will be looked for from the engine designer, while some progress in fuels for limited fields of use requiring this will be expected. He also stated that better lubricants will be necessary if higher power per cubic inch of displacement is to be attained without impairing engine life.

Meanwhile, he averred, the gradual reduction cost per horsepower should open up new fields of application where high-use factor, moderate-load factor, and safety are important considerations.

Prof. Fezandie compared the automotive diesel with its stationary prototype and listed its pros and cons in relation to the gasoline engine. In the latter comparison he stated that the diesel uses somewhat cheaper fuel (at present) and considerably less of it for the same power developed. The diesel's handicaps of high first cost, weight, smoke and odor, high maintenance costs, lack of curb service, rough idling, and hard starting, are being steadily reduced, he said, and reported progress that has been made on each of these counts.

DISCUSSION

F. Glen Shoemaker, Detroit Diesel Engine Division, General Motors Corp., challenged remarks by Prof. Fezandie on limitations of diesels. There is no indication, he said, that the diesel process is a limitation of any diesel engine. Inherent limitations, he said, are getting air into the fire box and temperature stresses. As we get materials of increased temperature resistance for linings of the fire box, and other parts, he said, more output will be obtained.

Answering, Prof. Fezandie voiced his opinion that the diesel engine would be limited in speed beyond what the gasoline engine would be because of period of combustion. He agreed as to temperature.

Requirements of a Smoke Meter – KENNETH M. BROWN, Caterpillar Tractor Co.

SMOKE is objectionable and also an important criterion of diesel engine performance. It also affects useful life and periods between overhauls, hence the need for indicating small changes in smoking. To eliminate human elements in visual observations and secure dependable readings, a smoke meter using a photo-electric cell was developed by Mr. Brown. In this meter, Mr. Brown said, smoke is drawn into a tube 36 in. long with dead air spaces at the end and light is passed through the smoke and onto the cell. The meter is said to fill the conditions of being sensitive to the range of values to be measured. Light intensity is capable of easy and smooth adjustment and remains constant for any setting. Windows do not become dirty quickly and are easily cleaned. Ease of operation is attained and the meter is portable. Factors affecting use are discussed and various advantages of the design are pointed out. To obtain a numerical value of smoke density which is convenient, it is proposed that the standard length of smoke column be taken as 100 meters. Universal use of the scale proposed would allow the same interpretation of readings by everyone.

The Development of an Instrument for the Measurement of the Ignition Quality of Diesel Fuels – WILLIAM H. BROWNE, Caterpillar Tractor Co.

NEED for a simple, accurate, rapid and reproducible instrument to determine diesel fuel cetane numbers led to the development of the Caterpillar cetane valve, a butterfly valve equipped with a graduated quadrant, Mr. Browne stated. The valve was used to reduce intake pressure until ignition lag became so great that misfire occurred. The position of the valve at the instant of misfire, when referred to a calibration curve, gives the cetane rating of the fuel. With the original type of valve, the curve required daily checking. By a process described, the design was altered to give a straight line calibration, but still daily calibration was required. A third design overcame this fault and "cetane ratings can be determined directly by the instrument." Further tests investigated the effect of the valve on fuel ignition, and it was concluded that the valve rates fuels solely by control over the compression pressure. Applications to engines of different size were then investigated and satisfactory operation was attained in one case. In another, difficulties remain to be "ironed out", but the utility of the instrument appears to be established.

A Procedure for Determining Diesel Nozzle Spray Characteristics – H. F. BRYAN, International Harvester Co.

AS the combustion efficiency of a diesel engine depends largely on the fuel discharge characteristics of the injection system, Mr. Bryan pointed out, the fuel spray characteristics must be known if a suitable basis for comparison is to be established. He described equipment and test procedure for determining fuel spray characteristics on International-Harvester Co. diesel engines.

The characteristics of major importance were named as: fineness and uniformity of drop size; fuel volume in the combustion chamber at any instant of the injection period and delivery rate from nozzle; penetration of the fuel spray under different densities and temperatures; injection lag; form of fuel spray at any instant; and dispersion of spray during injection.

After describing the test equipment and the methods of using it and giving graphical performance data typical of specific injection systems, the author concluded: "With continued improvement in test equipment and technique, it is believed that, eventually, specifications for a diesel engine injection system can be worked out on the bench when once the demands of the combustion system of the engine are known."

Two Devices for Improving Laboratory Precision – L. W. GRIFFITH and E. R. WILLERTH, Shell Oil Co.

INTAKE ports of two-cycle diesel engines sometimes become partly clogged with foreign products. In laboratory tests, a record of the exact condition of ports is necessary and removal of inspection plates exposes only a few ports. To view all the ports simultaneously, a conical mirror is used to reflect images of the ports and permit of

photographing them. The mirror is set, with its base horizontal, on the piston head and the camera is placed vertically above the center line of the cylinder. Even though the image is distorted, an accurate estimate of the amount of clogging is secured, the authors stated.

For reliable checking of exact engine speeds, the authors have also made use of a stroboscopic tachometer which is described. It involves use of a neon light which, on a 60-cycle line, flashes 7200 times a minute. The flywheel rim is divided into 12 spaces and alternate ones are painted white. At 1200 rpm, 7200 white spaces pass a given point per minute and the flywheel appears to stand still. Deviation from this speed gives apparent slow rotation. If the engine is to run at other speeds, the number of white spaces can be varied and the speed checked at 600, 800, 1200, 1440 and 1800 rpm if suitable methods of viewing different bands separately are arranged. One of the chief advantages of the device is its simplicity.

A Method for Measuring Diesel Fuel Ignition Lag – W. S. MOUNT, Socony-Vacuum Oil Co.

THE instrument described by Mr. Mount incorporates many features utilized in other designs and is currently used on a CFR engine, though designed for use also on other engines. Essentially, Mr. Mount said, the meter is an electronic switch, turned on by a voltage impulse from injection contact points and off by closure of combustion contact points. Current is accumulated by a large condenser and continuously discharged through a micro-ammeter throughout a 720-deg cycle. Changes in ignition lag are indicated as changes in the micro-ammeter reading, but most cycle-to-cycle variations are damped out. Increased sensitivity results from depressing the scale zero electrically. "Changes in reading with changes in lag are nearly linear and variations can be read to 1/25th deg on a 100-division scale." A time delay circuit avoids overloading the meter through chattering of injection contacts. Another safety feature is a sensitive mechanical relay used as an overload circuit breaker. A wiring diagram and an explanation thereof were given by Mr. Mount and the procedure employed for cetane ratings was outlined.

A Dual-Range, Vernier, Electric Tachometer – H. V. NUTT and W. F. JOACHIM, U. S. Naval Engineering Experiment Station (Presented by Mr. Nutt)

SINCE ordinary tachometers produce only relatively coarse indications of speed, the authors described one which, they stated, "can be read accurately to less than 1 rpm." It has two scales, they explained, one ranging from zero to 1000 rpm and a second (vernier) scale ranging from 700 to 800 rpm.

Essential parts of the tachometer named by the authors include a d-c magneto developing 0.4 v at 1000 rpm; a highly damped millivoltmeter with 7-in. scale and having a full-scale deflection at 20 mv; a dry cell; two wire-wound potentiometers of 238 ohms and 500 ohms, respectively; two wire-wound rheostats of 10 and 205 ohms; and one three-pole single-throw switch.

These parts are arranged for connection in two different circuits, one for each respective scale, the authors explained. When used on a 750-rpm diesel engine, they reported, "small changes in speed down to 1 rpm, caused by erratic governor operation, valve sticking and changes in engine friction can be accurately read on the 7-in. scale at a distance of 10 to 15 ft." The range of usefulness can be considerably extended by various modifications in the basic circuit, they pointed out.

Use of the Oscillograph for Testing Fuel Injection – P. H. SCHWEITZER, Pennsylvania State College.

A CATHODE ray oscillograph is used for routine testing at Pennsylvania State College because it is quickest and most informative, Prof. Schweitzer said. Both the Sunbury and a modified RCA indicator are used. Line pressure diagrams are taken either near the pump or near the nozzle. As the Sunbury indicator utilizes electromagnetic pickups, it is particularly suitable for ignition timing, the pickup being mounted close to the protruding end of the needle. The RCA indicator uses a piezo-electric crystal suitable for pressure recording but not for needle displacements, hence it was modified. An electrical integrator has been built to use with the electromagnetic pickup. Use of a feedback circuit corrects for the voltage on the integrating condenser and enables an exact integration. A degree scale marker is combined with the integrator and causes the oscillograph to trace a dashed line with dashes two degrees apart, giving an accurate horizontal scale. In most cases, Prof. Schweitzer stated, all necessary information can be obtained without an accurate vertical scale but the latter is not hard to get by means described.

The Rose Indicator for Study of Combustion in Internal-Combustion Engines – G. C. WILSON, University of Wisconsin.

"AS many as five important occurrences preceding and during combustion in an engine have been recorded simultaneously" with the Rose indicator the elements of which Prof. Wilson described briefly in presenting his paper. "There is," he said, "considerable flexibility in the choice of occurrences which the investigator may select for study." Condensed information on the main elements of the Rose indicating system, as used in the Heat-Power Laboratory at the University of Wisconsin, was given by Prof. Wilson under the headings: (1) multiple pickup and amplifying apparatus; (2) three-tube cathode-ray oscillograph; (3) revolving-drum camera; and (4) dead-center indicator. He displayed a diagram that shows these elements and how they are connected. Item (1), he explained, includes a fuel injection indicator having a light shutter fastened directly to the needle valve of the fuel injector; a radiation indicator involving a photo-electric cell and amplifier; and a pressure indicator in which an RCA quartz-crystal, piezo-electric pickup is used. Among the accomplishments made possible by the indicator, he reported, is the measurement of time "within 1/100,000 sec."

DISCUSSION

Discussion at this session consisted largely of questions and answers. H. L. Knudsen, Cummins Engine Co., asked whether the effects of penetration had been considered in developing the cetane valve, and W. H. Browne replied that it had not. Prof. P. H. Schweitzer, Pennsylvania State College, said that other investigation had shown that ignition lag is affected primarily by temperature and pressure, chiefly temperature, and that penetration, air-fuel ratio and other factors are not of significance in regard to lag.

In discussing the dual-scale tachometer, Earl C. Rieger of International Harvester, indicated that his company had been getting away from using electric tachometers, partly because both the magneto and the meter used are subject to about $\pm 1\%$ error. This has led to the use of stroboscopic devices when small speed differences must be indicated. To this H. V. Nutt replied that magnetos differ in characteristics and accuracy and one with a straight line voltage-speed scale should be chosen. If this is done and the magneto is of a high precision type, readings within 0.2% can be had. In the meter, absolute accuracy is not so important as relative accuracy which is determined by calibration. Stroboscopic devices are good when a current source giving a constant cyclic rate is available.

Asked by O. D. Treiber whether he had investigated the effect on lag of temperature, pressure, turbulence and cetane rating, H. F. Bryan said that he was not specially interested in cetane ratings in this connection as the farmer who uses most I.H.C. equipment is likely to employ whatever fuel happens to be available. Lag varies, however, with wall temperatures, and the quantity of fuel in the pre-combustion chamber at a given time varies, of course, with the lag.

In discussing the paper on a smoke meter, Mr. Treiber pointed out that there are three kinds of smoke: white, blue, and black, and asked whether any efforts to differentiate between them had been made in using the meter. K. M. Brown indicated that the meter gives a composite measurement, being sensitive to all types. There was some question as to how the types could be separated. T. A. H. Jeffery of Detroit-Edison Co., pointed out that one should consider the temperature of the photo-electric cell unless a type not affected by temperature is used.

TRANSPORTATION AND MAINTENANCE SESSIONS

Chairmen

G. W. Laurie **T. L. Preble**

The first Transportation & Maintenance Session, opening the meeting Monday morning, brought general agreement from laboratory men and operators that, while exhaust-gas analyzers have certain limitations, they are valuable instruments if their limitations are taken into consideration, particularly if they are used in connection with other equipment. At the second session of the Activity, Tuesday afternoon, brake equalization problems were considered by truck and trailer manufacturers, brake specialists, and the men responsible for their maintenance.

Characteristics of Exhaust Gas Analyzers – J. L. DILWORTH, Pennsylvania State College.

CONFLICTING views of experienced maintenance men on the accuracy of the exhaust-gas analyzer in determining air-fuel ratio, Mr. Dilworth said, stimulated a critical study and numerous actual tests of various exhaust-gas analyzers with a view toward securing some dependable information on the actual performance of these instruments.

The tests, Mr. Dilworth explained, were all conducted at Virginia Polytechnic Institute on a single-cylinder, variable-compression test engine in order to eliminate, or permit the control of, as many variables as possible. He further explained the laboratory set-up and gave full detail of the method of conducting the tests.

Six exhaust-gas analyzers were tested, he reported; two of the widely used thermal conductivity type, one of the hot-wire catalytic type, one of the relative density type, and two employing the Orsat principle. Mr. Dilworth commented that while these do not represent all the makes on the American market, they represent every general type which is applicable to automotive service.

Probably the most striking thing shown, he reported, is that every instrument practically ceased to function when the air-fuel ratio became leaner than 14:1. He also noted that the effect of changes in exhaust pressure on the accuracy of exhaust-gas analyzers appeared to be rather pronounced. In most cases, he added, manufacturers of the instruments have utilized various devices in an attempt to minimize the effect of rate of flow.

It would appear from the results of these tests, he said, that exhaust-gas analyzers are not precision instruments, being likely to err as much as one-half of one air-fuel ratio, even under favorable conditions. He likewise noted that all exhaust gas analyzers are calibrated for regular commercial gasolines, and that they must have special calibration for any fuel with a different chemical composition.

DISCUSSION

E. P. Gohn, test engineer, Atlantic Refining Co., the first man called upon by Chairman Laurie to present prepared discussion, emphasized that the fleet man's primary interest in the exhaust-gas analyzer is its use as a tool for adjusting the engine to get better operating efficiency. Fuel expense, he pointed out, is second only to driver expense in many fleet operations.

By using a single-cylinder engine, Mr. Gohn averred, the important variable of manifolding was not introduced as a possible source of error resulting from uneven mixtures, in the tests reported by Mr. Dilworth. Even by using the best exhaust-gas analyzer available, he added, we can only obtain an indication of all cylinders mixed together and exhausting into a common outlet. Further, he said, in attempts to reach the air-fuel ratio for maximum economy, adjustments to the carburetor may result in dangerously lean mixtures to those cylinders normally being supplied by a somewhat lean ratio.

Commenting on the author's statement that, in general, exhaust-gas analyzers fail to register ratios leaner than 14:1, Mr. Gohn suggested that adjustments of the carburetor must be made to register on the indicator to avoid getting too lean a mixture.

The exhaust-gas analyzer, like most instruments, gives certain indications only; when interpreted correctly and used together with other data, it has its place in the modern instrumentation of engines for increased performance and general operating economy, he stated.

The national-defense aspect of exhaust-gas analyzers as instruments used in keeping Army equipment operating at the greatest fuel economy, was emphasized by Lt.-Col. Mark V. Brunson, Quartermaster Corps, who revealed that vehicles of one armored division require 100,000 gal of gasoline for one filling.

Col. Brunson said that the two types of analyzers found of practical use to the Army are the thermal-conductivity type and the hot-wire catalytic type. He urged that a method be found to limit the analyzer's indication within its inherent accuracy.

That a solution has been found to the problem of constructing exhaust-gas analyzers which will register air-fuel ratios greater than 14:1, was indicated by Errol J. Gay, Ethyl Gasoline Corp., who stated that a manufacturer has built one that will read accurately to 16.5:1, and is using the device in its own activities. Another company, he added, is well beyond the experimental stage and should be able to produce such an instrument within the next year.

Many errors in the setting of carburetors could be corrected if they were checked on the road using an accurate exhaust-gas analyzer, Mr. Gay contended. He noted that there is not enough difference in the carbon-hydrogen content of present day fuels to make appreciable errors in readings, but that benzol or alcohol blends do change the scale calibration. He also noted that changes in barometer or temperature will affect the readings and must be considered when evaluating final results.

Agreeing with Mr. Dilworth that the analyzers, in general, are not very sensitive at mixture ratios leaner than 14:1, W. G. Lovell, Research Laboratories Division, General Motors Corp., stated: "unfortunately for the instrument and fortunately for the cars . . . many present-day cars operate at road load at mixture ratios much leaner than this, so there are some practical conditions under which exhaust-gas analyzers are not especially useful. However, at richer mixtures . . . they may be made quite sensitive and accurate."

Mr. Lovell stated, however, that these instruments, when properly used and calibrated offer so many advantages from the standpoint of reliability, convenience, and speed, that they seem essential for many problems in the development and servicing of carburetors, induction systems, and engines.

H. O. Mathews, Public Utility Engineering & Service Corp., commented that it is not enough to have only an exhaust-gas analyzer – and suggested that it is best used with a chassis dynamometer, and explained its use in conjunction with a vacuum gage. He asked what effect increase of octane number of fuel would have on exhaust-gas analyzers, and was told by Mr. Dilworth that changes in octane rating would not require changes in calibration, if carbon-hydrogen ratios are not affected. However, Mr. Dilworth added, these ratios are changed with the mixing of cracked and regular fuels, requiring re-calibration of the instrument.

***Brake Equalization between Truck-Tractors and Trailers* – JOHN W. VOTYPKA, chief engineer, Fruehauf Trailer Co., and E. VANCE HOWE, Bendix-Westinghouse Air Brake Co. (Presented by Mr. Votypka)**

THREE highly important considerations are brought out in a study of braking of truck-tractors and trailers, the authors reported:

1. A braking system adequate in design and capacity for the rated load of each individual vehicle unit.

2. The proper adjustment and maintenance of the brakes of the entire train so that each bears its proper share of the braking load.

3. Operation control so that the concentration of the brake load is not too heavy upon any individual drum or axle in relation to the braking efforts on other units.

Their paper, they explained, concentrates on the second two considerations since it deals primarily with the foundation brake (brake-shoe mechanism) phase of the problem.

Most of the chronic braking troubles, the authors contended, could be eliminated if the brakes were *balanced* and then subjected to a well-planned and executed periodic maintenance program. Such a program, they added, has given a number of operators both finer brake performance and lower maintenance cost.

In summarizing the steps to take to accomplish brake balancing, they emphasized the following points: keep brake shoes and brake rigging clean; lubricate cams and cam followers regularly; lubricate hinge pins regularly; blow dust out of brake drums at frequent intervals; use proper brake-shoe return springs; use same lining on all wheels; replace lining on all wheels at the same time; turn drums frequently enough so that lining life and brake performance do not suffer due to poor drum condition; check all wheels when one wheel gives repeated trouble.

In discussing the operating control of the brakes, they brought out the importance of the human element, "the most baffling of all factors in any problem," contending that it must be eliminated for uniform and exact performance.

DISCUSSION

Chairman Preble set off discussion of the Votypka-Howe paper with the comment that too many operators throughout the country are not brake conscious, and warned the operators that unless they do something for themselves, legislative bodies are apt to do something for them. This was backed by David Beecroft, Bendix Products, who declared that there is no question but that vehicle operators are at the cross-roads, with the choice of establishing better maintenance requirements among themselves or facing more stringent inspection requirements established by regulatory bodies. He also noted that while the regulatory bodies will not interfere with design, they are looking to manufacturers to do a job.

Charts presented by Stephen Johnson, Jr., Bendix-Westinghouse Automotive Air Brake Co., emphasized the authors' remarks on the benefit of a brake balancing program. He showed how mechanical adjustment of a vehicle with poorly balanced brakes sharply reduced the stopping time and distance required.

Recognizing the importance of synchronization between tractor and trailer brakes, Merrill C. Horine, Mack Trucks, Inc., brought up the difficulty of obtaining synchronization in cases where shuffling or interchange of trailers take place. He voiced the opinion of several discussers when he stated that synchronizaton is practical only when tractor and trailer stay together and have brakes of comparable characteristics.

Mr. Horine put his finger on a timely question when he declared that the hand control valve for trailer brakes should be removed from all tractor-trailer combinations. Designed originally for snubbing on hills, he said, they are more often used in billiard-table country. When most or all of the braking is on the last two tractor wheels, he explained, a skid is apt to result – and it is equally dangerous in an emergency when the driver instinctively first puts his foot on the pedal controlling the tractor brakes. Maximum braking efficiency, he noted, is when simultaneous braking effort is applied to all wheels matched to the load it is to accommodate.

Lt.-Col. Mark V. Brunson, Quartermaster Corps, concurred with Mr. Horine's contentions, as did other operators. Fred L. Faulkner, Armour & Co., noted that none of the vehicles in his fleet have hand controls, but added that he has seen situations where they would help a bit. He referred particularly to older vehicles whose brakes are difficult to keep synchronized. The drivers of such units, he said, seem to be able to keep the train better under control by using the hand control.

J. Willard Lord, Atlantic Refining Co., pointed out that the hand control is a makeshift, put on to offset the unbalanced braking of early power brakes when operated from the foot pedal. We will hang on to this makeshift until *we can and do* keep power brakes in synchronization, he declared.

T. C. Smith, American Telephone & Telegraph, argued that it would be a costly procedure to keep brakes in perfect synchronization at all times and to have them operate from one pedal.

Mr. Beecroft commented that inspections made by a Federal regulatory body indicate that some 90% of the vehicles inspected have had lubrication and other service of braking systems neglected.

TRUCK, BUS & RAILCAR SESSIONS

Chairmen

B. Frank Jones **R. S. Reed**

Truck, Bus & Railcar Sessions centered around developments leading to present motorcoach design, and the future in store for express highways.

***Structural Developments in Motor Coach Design* – MERRILL C. HORINE and HARRY S. BERNARD, Mack Trucks, Inc. (Presented by Mr. Horine)**

DEVELOPMENT of structural design has progressed further in motor coaches than in any other class of automotive vehicle, Messrs. Horine and Bernard asserted, explaining that this development has been goaded by stringent economic exactions on the one hand and abetted by operating conditions which, while perhaps the severest to which highway vehicles are subjected, are more nearly uniform than any others.

The development of bus structures were traced by the authors from early beginnings to the present era of unitized, functional design in which multi-purpose parts, stronger and lighter materials, new methods of fabricating and joining the parts, and more scientific distribution of stresses.

Examples of the trend of development and of present-day practice were illustrated by photographs and samples of construction. The authors concluded their paper with a summary of possible future developments, with the statement: "We may be certain . . . that the development of any or each of these future buses will be a gradual and sometimes painful process of trial and error, fraught with many disappointments as well as gratifying surprises. The same elusive goal toward which present efforts are being unceasingly directed – lighter buses, more agile, easier of control, more economical and much more pleasing to the eye, with greater convenience and comfort for passengers – will surely be the objective of all, regardless of how divergent the paths of development chosen."

DISCUSSION

At Chairman Jones' call for discussion, F. B. Lautzenhiser, International Harvester Co., asked Mr. Horine what materials seem to be in most favor in motorcoach construction.

In response, Mr. Horine stated that high-tensile steels

are being widely used in somewhat thinner sections than mild steels, but not of the paper-thinness that 18-8 stainless steels are used. Also in favor, he said, are aluminum panels, duralumin, extruded aluminum for parts which have little or no stress, and chrome-molybdenum tubing.

Robert Cass, White Motor Co., pointed out that there is a trend toward more practical testing and less theoretical testing of motorcoach designs. Mr. Horine agreed, and commented that tests must be made full-scale to eliminate scale effect.

***Toll Roads and Truck and Bus Transportation* – CHARLES M. NOBLE, special highway engineer, Pennsylvania Turnpike Commission.**

THE immediate construction of a system of express toll highways serving areas embracing 65% of the nation's industry, 50% of its assessed valuation, and 40% of its population, is entirely feasible and practical, stated Mr. Noble, citing Hon. Walter A. Jones' (chairman of the Pennsylvania Turnpike Commission) proposal for a highway offering "de luxe transportation for all classes of traffic from the industrial middle west to the ocean ports of the Atlantic seaboard that will serve the nation in peace or war." This, he said, would cost about $860,000,000 and could be financed by revenue bonds, such as were used in the financing of the Pennsylvania Turnpike, the George Washington Bridge, the Lincoln Tunnel, and other public improvements.

Referring to the Pennsylvania Turnpike as a "proving ground which is successfully demonstrating the principle of the revenue bond, the user paying a service fare for the privilege of utilizing the features of a modern express highway," he told some of its advantages over regular highways. On a state road paralleling the turnpike, he said, there are 939 intersections, 25 stop lights, and 11 railway grade crossings. On the turnpike there are none.

Bus and truck operators, pressed by faster passenger and freight services offered by the railroads, he said, are expected to more and more realize the value of express highways which will permit "on-time" schedules, allowing operation at selected speeds without traffic tangles. He pointed out that at 15 mph it requires two and one-half 8-hr shifts to make a 300-mile trip, while at 38 mph it can be done in 8 hr.

Mr. Noble noted that the construction of express highways will create problems for the automobile designers and manufacturers. They will have to build vehicles, he said, that will operate safely and economically at higher cruising speeds.

DISCUSSION

First to answer Chairman Reed's call for discussion was Murray Fahnestock, editor, *Ford Field Magazine,* who emphasized that express highways must be considered as a part of the whole highway system. Referring to the Pennsylvania Turnpike, he stated that it concentrates traffic and "spews vehicles into cities at its terminals." Time gained by use of an express highway, he commented, might be lost after it is left, due to traffic congestion which the highway is apt to create. He cited present congestion in Pittsburgh as an example.

Mr. Noble was in thorough agreement with these remarks. The Pennsylvania Turnpike at present "begins nowhere and ends nowhere," he said. Extensions are planned, he added that will take traffic through the outskirts of Pittsburgh. He indicated that through traffic of future express highways will bypass cities, and in so doing will leave present highways with lessened loads for local traffic.

The question of weight limitation was brought up by J. F. Winchester, Standard Oil Co. of N. J., who wanted to know if greater loads were permitted on the Pennsylvania Turnpike than on other highways in the state. Mr. Noble replied that, at present, state codes are assumed to apply to the Turnpike – adding that the vehicles using it come from and proceed to other state roads, and that if higher loads were permitted on the Turnpike operators taking advantage of the increase would have to transfer cargos at each end. He indicated that future highways crossing states from border to border would probably not limit loads below the limits of the adjacent states. Pennsylvania, he added, is considering increasing the weight limit on several of its through routes.

The building of the Pennsylvania Turnpike was the topic of a sound film shown by the Portland Cement Association at the close of discussion.

FUELS & LUBRICANTS SESSIONS

Chairmen

W. M. Holaday **Neil MacCoull**

Fuels – with an emphasis on improvement in mixture ratios and comment on the ground work for the 1940 Cooperative Road Knock Tests by the Cooperative Fuels Research Committee – made up the important Friday morning Fuels & Lubricants Session. In the afternoon, lubricants were discussed. Engine designers were told what they can do to lessen lubrication problems, and developments in new lubricants for heavy-duty diesel engines were reviewed.

***A Thirteen Year Improvement in Mixture Ratios* – W. G. LOVELL, J. M. CAMPBELL, B. A. D'ALLEVA, and P. K. WINTER, Research Laboratories Division, General Motors Corp. (Presented by Dr. Winter)**

BETWEEN 1927 and 1940 there has been a considerable improvement in the direction of leaner air-fuel mixtures used in representative cars, amounting to an average of about two ratios at road load, equivalent to a saving of about 18% in fuel consumption, the authors stated in reporting data collected in surveys of mixture ratios used in representative groups of cars in 1927, 1933, and 1940. These data, they added, also suggest that there is a possibility of still further gains.

The air-fuel ratios used in automobiles, they commented, are of special interest as representing the engineering compromise that must be made between the relatively lean mixtures which are desirable from the standpoint of economy of fuel, and the richer ones which are necessary because of inherent imperfections in commercial induction systems.

Comparisons of mixtures used by the cars tested in the three years were given on graphs showing average and range of air-fuel ratios plotted against miles per hour at road load and full load, and per cent of energy loss plotted against miles per hour at road and full load.

***1940 Cooperative Road Tests – A Report from the Cooperative Fuel Research Committee* – J. M. CAMPBELL, General Motors Research Laboratories Division, General Motors Corp.**

MR. CAMPBELL summarized methods used in the most thoroughgoing research job ever done on any series of CFR road tests. Test methods previously used, he explained, have been found not to provide sufficient information for present needs concerning the fuel requirements and knocking characteristics of engines. The new methods of approach which have been developed, he pointed out, furnish needed information relative to the fuel-and-engine relationship that heretofore have been obscure, and indicate paths for future developments. He predicted that widespread utilization of the principles worked out in these tests will result in a more effective utilization of fuel antiknock characteristics and more effective adjustment of ignition timing to meet the requirements of current motor fuels.

To indicate the scope of the work which has extended over most of the past year, Mr. Campbell reported that, in the concluding and most important phase – the centralized road tests at San Bernardino, Calif. – 32 organizations were represented. In these concluding tests, he revealed, a study was made of the characteristics of 23 fuels repre-

senting a wide variety of fuel types and the complimentary behavior of 24 different automobiles. During this latter period alone, he said, the 24 test cars were driven over 100,000 miles. The report prepared to present the mass of data obtained runs to 450 pages.

In conclusion, he expressed appreciation for the generous support given the work by the cooperating organizations and their representatives who actively participated in the tests.

DISCUSSION

Discussion centered on the Lovell-Campbell-D'Alleva-Winter paper.

The authors' paper certainly refutes charges that underhood advance has lagged while emphasis has been put on chrome trimmings, was the comment of the first discusser, C. E. Cummings, The Texas Co., who reported studies made by his company which supported the authors' findings.

Much of the discussion centered around the air-fuel ratios in different cylinders. A. Townhill of Thompson Products, Inc., reported that he finds many fleet owners put in lean jets and get overall air-fuel ratios of 16:1. What, he asked, is the range to be expected in different cylinders? Dr. Winter said that there is a wide range – and when pressed further said that in very bad cases where the overall ratio was 15:1, the extremes might be 20:1 and 10:1. Perhaps, he added, two ratio units difference would be found normally.

Mr. Townhill later entered the discussion to reply to a question as to how high air-mixture ratios can go without running into oxidation that will result in shortened life of valves and other parts. He stated that in influencing fleets to reduce air-fuel ratios to 14:1, he has found that there has not been much lost in miles per gallon, and that valves last much longer. At higher ratios, he continued, perhaps one or two valves will fail. This, he believes, is due to uneven distribution.

A diesel engineer stated that diesels run on high ratios, even up to 20:1 at low loads, and asked why this can't be done with gasoline engines.

A question by J. P. Stewart, Socony-Vacuum Oil Co., as to effect of mixtures on performance at low speeds, led to the observation by Stanwood Sparrow, Studebaker Corp., that a rich mixture is required to avoid missing at low speed because of the inert gas present in the cylinder. He also told of being able to use leaner air-fuel ratios by shifting the location of the spark plug.

Engine Design vs. Engine Lubrication – R. J. S. PIGOTT, Gulf Research & Development Co.

COMMENTING on the number of special oils which have been developed to meet demands of a particular engine, class of design, or service, Mr. Pigott stated, "It looks as if the program is getting to be 'prescription' oils for too many cases. Look at the defense situation," he said, "the Army and Navy will want not over four oils for all engine purposes – How can they possibly handle 15 or 20 prescription oils for particular designs?"

He declared that many of the prescription oils are the result of calling in the chemist to solve engineering problems.

In summarizing his comments on lubricants, he made the following points: (a) Unnecessary high bearing temperature is the major factor in present lubrication problems and the hurried development of an army of special oils. (b) Oiling systems can be, and for the future must be, designed, not whittled. (c) Bearings must be made rigid enough to function at full advantage, and oil flows must be great enough to do the necessary cooling at reasonable temperatures for the oil. (d) External coolers should be used. (e) The mania for very light oils and completely "drying up" the engine should be reconsidered. (f) While compounded oils are here to stay, "it is certainly bad judgment to keep calling for more and more special products, when what is needed is adequate designing to avoid that call." (g) Crankcases should be designed to drain dry.

Turning to fuels, Mr. Pigott pointed out that during the past 10 years the improvement in engine horsepower has been 20% due to increase in compression ratios, following improvement in octane rating of gasoline, and 80% due to straight engineering design. If high horsepower is desired, he stated, supercharging is a good way to get it without going to synthetic chemicals for costly high octane gasoline. It costs millions, he said, to increase octane number a couple of points. He suggested that if supercharging is adopted "full intercooling should be used to cut down work for compression, lower terminal temperature to ward off detonation, and deliver a denser charge for high horsepower."

DISCUSSION

Questions on the grooving of bearings lead Speaker Pigott to comment that there has been no real study of this subject, and that it should be undertaken. Asked by C. H. Taylor of Bendix Aviation, how much real good dirt grooves do, he answered it depends upon the condition of the oil, and averred that we must have them. To another discusser, he said that it is possible to make changes that will pass more oil through the bearings, although less total oil will be consumed.

While engine manufacturers indicated that oil men are resting on their oars, they also complimented them on their accomplishments. They predicted that engine temperatures will continue to increase and, as to fuels, that in increasing compression ratios they have not yet reached the point of diminishing returns. B. E. Sibley, Continental Oil Co., supported Mr. Pigott's plea for better engine design, indicating that there are limits as to how far oils can go in performing functions of the engine. Mr. Pigott remarked that engineers have reached the place where they should look back to see if they have missed any bets.

Lubrication of Severe Duty Engines (Diesels) – J. G. McNAB, W. C. WINNING, B. G. BALDWIN, and F. L. MILLER, Esso Laboratories, Research Division, Standard Oil Development Co. (Presented by Dr. Miller)

DIESEL engines, like gasoline engines, the authors stated, differ considerably among themselves in the burdens they impose upon the lubricating oil, and consequently in the lubrication problems they raise. They pointed to differences in design which result in significant differences in heat flow and distribution in the engine, which may in some cases cause emphasis to be put on such problems as ring sticking, wear, and piston scuffing, and in others, on sludge formation, varnish, coking, and so on.

Naphthenic and paraffinic oils of 40 and 100 viscosity index, respectively, to which have been added small amounts of a detergent-disperser-inhibitor type additive developed by the Esso Laboratories, have been subjected to extensive laboratory and field tests and have been found to meet the most severe requirements of heavy-duty diesel service in modern transportation and industry, they stated. Results of some of these tests were compared with results of similar tests on typical naphthenic and paraffinic mineral oils commonly used for diesel lubrication under moderate conditions of speed, load, and temperature where extreme detergency and oxidation stability are not required, on another detergent-disperser-inhibitor blend in a naphthenic base oil and on a commercial inhibited oil of the paraffinic type used in diesels requiring extreme oxidation stability but only a little detergency.

They noted that the research forming the basis of their paper was carried out principally on three of the better-known makes of diesel engines, selected because they represented three rather distinct types of engine design and because each manifested certain of the characteristic lubrication problems which, considered together, included practically all of those peculiar to the diesel engine.

DISCUSSION

A slight skirmish on the subject of oil filters and their effect on compounded oils marked the discussion of the Standard Oil engineers' paper. Suggestion that with filters products of oxidation can be removed from the lubricant as they are formed without the use of inhibitors, was made by Chase Donaldson, Briggs Clarifier Co. He also main-

tained that filter elements with adsorbent clay have been worked out that will not adversely affect the newer, more stable types of additive oils. He urged further research as to the ability of straight mineral oils, in conjunction with filters, to obtain the end sought by the development of the compounded lubricants.

Dr. Ulric Bray, consultant, contended that he knows of no fullers earth that will not take too much additive out of compounded lubricants. Dr. Miller stated that the oil companies have no quarrel with filters – and that under some conditions their use is imperative. Improved engine design, improved lubricants, plus proper filter and oil-change practice, is the combination that will accomplish what is wanted, he said.

In the production of compounded lubricants, Dr. Bray urged that the base oil be stable against oxidation and low in carbon formation.

When the question of the cost of improved lubricants comes up at these meetings, said F. Glen Shoemaker, Detroit Diesel Division, General Motors Corp., the answer is always "more" and everyone goes home. The commercial advantages must be stressed, he averred, and cited an instance where the use of a compounded lubricant gave 360 miles per qt, as compared to 60 miles per qt for straight mineral oil. It is evident that in the future oil companies will sell less oil to their customers and get more for it, he concluded.

Prepared discussion by George L. Neely, Standard Oil Co. of Calif., stressed the complexities of properly selecting additives in development of compounded oils for heavy-duty engines. He cited improvements that have been made in these lubricants, and predicted that there will be still further progress made during the next several years. He also said that, in his opinion, these developments will be found applicable, not only in diesel lubricants, but also in the motor car and aircraft fields. "There will come a time when all high-grade lubricants for internal combustion engines will be compounded," he said.

E. A. Ryder, Pratt & Whitney Aircraft, in prepared discussion read by Almon L. Beall, Wright Aeronautical Corp., told of the development of an apparatus for corrosion testing in studying oil stability, based upon the MacCoull scheme, but differing radically in design.

STEEL HARDENABILITY SESSION

E. F. Davis, Chairman

In an effort to find a standard method for predetermining the "hardenability" of steels (ability to harden under heat-treatment) four methods were presented at this symposium, and automotive metallurgists debated their advantages and disadvantages. The session was sponsored by the Subdivision on Hardenability of the Iron and Steel Division, SAE Standards Committee.

Use of Hardenability Tests for Selection and Specification of Automotive Steels – A. L. BOEGEHOLD, Research Laboratories Division, General Motors Corp.

SINCE the rate of cooling during quenching determines the hardness produced for any steel of particular composition, grain size, and carbide condition, this fundamental dependence of hardness exclusively on cooling rate should logically be the basis of classifying steels both for specification and selection purposes, Mr. Boegehold averred. A standard hardenability test procedure is necessary, therefore, he continued, for determining the relationship between hardness and cooling rate for each steel. The requirement that must be met by a standard hardenability test procedure, he declared, is that it shall furnish the relationship between hardness and cooling rate applicable to a wide variety of steels, section sizes, and cooling rates, and do it with a minimum amount of work.

In the major part of his presentation Mr. Boegehold discussed briefly some of the methods that have been suggested for testing hardenability, pointing out that the end-quench specimen is best suited for obtaining this fundamental relationship between hardness and cooling rate. He described the use of the hardness-cooling rate curve for determining cooling rates in objects to be hardened and also for predicting hardnesses that will be obtained upon such a part, depending upon the steel used.

A method of specifying hardenability of steels in terms of hardness-cooling rate curves was presented by the author, and the procedure for determining what the hardenability limits should be, was outlined. Application of this general procedure for selecting and specifying steels was illustrated in connection with a specific automobile part. Also described by the author was a method of interpreting hardenability information obtained from various hardenability tests in terms of hardness-cooling rate curves.

This translation of hardenability information from any test bar into terms of a hardness-cooling rate curve, he pointed out, permits the use of these various test bars for the purpose of predicting hardness in complicated-shaped articles. The H-CR curve, he explained, is the abbreviated name taken for convenience in referring to the hardness-cooling rate curve.

DISCUSSION

"Our experience indicates that the Jominy test is the most satisfactory hardenability test now available for a large group of the automotive steels," reported J. H. Jones, Republic Steel Corp., in prepared discussion read to the session by Chairman Davis. He explained that his laboratory had run several thousand standard Jominy test pieces and had released a considerable amount of steel by this method over the past 18 months. The major criticism that can be raised against adoption of the Jominy test, he pointed out, is that it does not give a very true picture of segregation. He contended, however, that this shortcoming by no means outweighs its advantages.

"We will welcome a simple standard test that will permit hardenability to be stated in a common term," he declared. He specified that such a test would indicate immediately not only whether the steel meets the hardenability requirements for the order for which it was made, but would classify it for possible application on any other order specifying hardenability, and without further testing.

H. B. Knowlton, International Harvester Co., the next discusser, agreed that the Jominy test "has the greatest possibilities and eliminates a lot of variables." Showing slides to back his points, he emphasized that more consideration should be given to hardness penetration after the draw so that the usable hardness at various depths below the surface can be determined more accurately, and explained the effect of different drawing temperatures on the Jominy specimen.

Mr. Boegehold's illustration of the use of H-CR curves for the selection of steels of desired hardenability, believes O. W. McMullan, Youngstown Sheet & Tube Co., represents the most simple, direct method of applying hardenability results that has been presented. In addition to a scientific procedure for determining actual hardness, he pointed out, a scientific method is needed for setting up the required hardenability limits with due consideration for the ability to meet such limits commercially.

In rebuttal, Mr. Boegehold gave his reasons for questioning the advisability of making hardness determinations on drawn test specimens, as recommended by Mr. Knowlton. In reply to another question, he declared that he had tried

to stress throughout his paper the desirability of using the H-CR curve regardless of the test specimen.

"Mr. Boegehold's paper has done more than any other paper to crystallize the subject of hardenability," Chairman Davis contributed.

A Method for Hardenability on Small Sizes – F. E. McCLEARY and R. WUERFEL, Chrysler Corp. (Presented by Mr. Wuerfel)

LIMITATIONS of the two general methods available for determining hardenability in steel, the authors pointed out, are that the test piece may not have a sufficient cross-section in which to develop the desired series of cooling rates, and that a special test piece (known as the L-type) must be machined for steels of low hardenability. The method described in their paper, they explained, is directed primarily toward removal of these two limitations.

The bomb used for this determination was described as a conical-shaped piece of steel provided with a hole concentric with the axis of the cone. This hole is enlarged at the top and threaded to take a plug which also provides the handle of the assembled bomb. The hole is slightly larger than the cylindrical test piece. This provides an annular space between the bomb and the test piece to be filled with a low-melting alloy, such as Wood's metal, which provides thermal contact between the bomb and test piece.

In use, the authors continued, the bomb is warmed above the melting point of the alloy, the required amount poured in, the test piece put in place, and the plug screwed in. The assembly is then heated to the temperature suited to the steel under test and quenched in water. The assembly is next warmed to melt the alloy and the test piece is removed. Hardness readings are taken along the length of the test piece and data are at hand for the calculation of the steel's "hardenability." This term, they explained, is used as defined by Grossmann and Asimow, and their procedure for calculating critical diameter gives a rating which may be made common to all other procedures.

Stated in terms of the critical diameter, they declared, the results of the method are reproducible within ⅛ in.

Determination of Specific Hardenability of Shallow-Hardening Steels – O. V. GREENE and C. B. POST, metallurgical department, The Carpenter Steel Co. (Presented by Mr. Greene)

AS a test for measuring the specific hardenability of shallow-hardening steels, the authors proposed use of a taper test specimen having a taper of 1 in. in 5 in. of length, ¼ in. in diameter at one end and 1¼ in. in diameter at the other end. In making the test, they explained that the hardened taper test specimens are split and Rockwell hardnesses are obtained along the central axis of the test specimen, or the central section may be etched lightly to bring out the relative colors of case and core. This taper test specimen, they revealed, has been correlated with the Jominy-Boegehold L-bar which enables the rate of cooling at any point along the central axis of the taper test specimen to be expressed in terms of deg F per sec at 1300 F.

Furthermore, the authors added, this taper test specimen has been correlated with the work of Grossmann and his associates concerning critical bar diameters and severity of quench. They showed experimental evidence that this degree of taper is small enough so that the taper test specimen behaves within experimental error like a series of round bars whose diameters are given by twice the perpendicular distance from the surface of the taper test specimen to any point along the center axis.

Correlation also is shown, they went on, between the Shepherd disc hardenability Nos. 10 to 16 inclusive, and the critical cooling velocity in deg F per sec at 1300 F (as determined from the cooling rates published for the Jominy-Boegehold Type L-bar) and critical bar diameters at a severity of quench of $H = 4.5$, or the "ideal critical bar diameters" for $H = \infty$.

DISCUSSION

Since the conductivity of rustless and stainless steels is from one-half to one-third that of plain carbon, Mr. Wuerfel explained, reading from prepared discussion, this limits the small end of a stainless bomb to a critical size of about ⅞ in. Water-hardening tool steels, he continued, run as low as ½ in. in critical size; this low hardenability limits the use of stainless. He reported that he had had good luck with water-hardening tool steels down to an analysis of 100-C and 0.15 Mn in a bomb made of 0.15 C and 0.22 Mn. The higher conductivity of plain carbon gives a critical size of ½ in. at the small end. Special design of the bomb or higher conductivity material, he pointed out, will allow smaller critical sizes should there be this need. In reply, Mr. Greene told Mr. Wuerfel that they did use bombs of the same material, and that their trouble was mechanical rather than metallurgical.

To Mr. McMullan's question concerning the taper of the bomb, Mr. Greene reported tests on bombs of steeper taper that did not give them the desired relation produced by the taper finally selected.

Correlation between Jominy Test and Quenched Round Bars – M. ASIMOW, W. F. CRAIG, and M. A. GROSSMANN, Carnegie-Illinois Steel Corp. (Presented by Mr. Grossmann)

ALTHOUGH recognizing that each of the different tests developed for ascertaining the hardenability of steel may be suited particularly to a specific problem, these investigators emphasized the usefulness of interpreting one test in terms of another. Hardenability of steel, they explained, is its susceptibility to hardening by quenching. They announced that their paper suggests a manner of correlating the extent of hardening in the Jominy-Boegehold end-quench test with the extent of hardening in quenched round bars.

The extent to which any particular steel hardens when quenched, they pointed out, varies with the cooling rate (cooling time) in the quench. That is, if cooled rapidly enough, it will become hard and, if cooled slowly, it will be soft so that, for each steel, a series of hardnesses may be found experimentally corresponding to a series of cooling times. Different cooling times, they continued, occur along the length of a Jominy bar, and various cooling times are also found at various positions in different sizes of quenched bars, quenched with various severities of quench. It therefore becomes possible, they concluded, to predict from the results of a Jominy test what the hardness distribution will be on the cross-section of a quenched round bar, when quenched with a known severity of quench.

DISCUSSION

Presenting his written discussion of all four papers, W. E. Jominy, General Motors Research Laboratories, first considered the question as to what hardness shall be chosen as the limiting value in making hardenability tests. For some steels, he pointed out, the point containing 50% martensite corresponding to Asimow and Grossmann's critical bar size is defined quite sharply whereas, for other steels, mainly the deeper hardening types, the point of 50% martensite is difficult to determine accurately. Although this limiting value can be used on the end-cooled bar, he continued, it has been found more convenient to use some minimum hardness value which would indicate a largely martensitic structure, and thus be assured of good physical properties to the limiting point.

There are many automotive parts, he pointed out, whose minimum hardness is required to be far in excess of that obtained with 50% martensite and certainly, in these cases, it is imperative to know the limiting cooling rates which will give us the required hardness for the steel being tested.

Since the test piece of Greene and Post is cooled on the end faces as well as the sides, Mr. Jominy continued, it is probable that the slowest cooling obtainable is equivalent to the center of a 1⅛-in. round brine-quenched bar, whereas the test bar of McCleary and Wuerfel has as its lowest cooling rate the equivalent of a 1⅜ in. round bar quenched in water.

Explaining why it may be some time before all four tests are correlated thoroughly and why certain discrepancies among the tests have arisen, Mr. Grossmann emphasized that hardenability is a complete behavior not a simple property.

Col. William Guy Wall

COL. WILLIAM GUY WALL, president of the Society of Automotive Engineers in 1928, died January 16, following a heart attack at his home in Indianapolis.

In 1898, Col. Wall built the first gasoline automobile to be constructed in Richmond, Va., and was the designer of the National car which, in 1911, won the first Indianapolis Race. Throughout the following 20 years, he was responsible for many significant contributions to automobile design, and played an important advisory role in development of military ordnance.

His participation in technical phases of automotive military equipment advancement stemmed from a rich background of interest and experience which began when he was graduated from the Virginia Military Institute in civil engineering in 1894. Two years later he attained his Bachelor of Science degree in electrical and mechanical engineering at the Massachusetts Institute of Technology. Only a few years later, he became engaged in the installation of steam and electric plants on United States warships under construction at the Norfolk Navy Yard and the William R. Trigg Shipbuilding Co. He assisted in changing from steam to internal combustion engines the powerplant equipment of the first American submarine, the Plunger.

When the United States entered World War I, Col. Wall joined the Engineering Division of the U. S. Army Ordnance Department and became a Lieutenant Colonel in the following year. In January, 1918, he went overseas with the American forces. Subsequently, he was transferred to the British Army and from there to the Sixth French Army. He was in the battles of the Somme Defensive, Leys and Aisne, and was recommended for the Distinguished Service Medal.

As a result of his work on improvements in the motorization of big guns, he was made Chief of the Motor Equipment Section of the Ordnance Department on his return to the United States. Until he was mustered out in 1919, he was engaged in designing tractor caissons and installing heavy guns on caterpillar self-propelled mounts.

He has been a prominent member of the SAE Ordnance Advisory Committee ever since the organization of that body in 1920, and was active along with other members of this committee in advisory work bearing on the present emergency at the time of his death.

Col. Wall was born in Baltimore, Md., on Aug. 7, 1875. He spent several years in electrical engineering work before entering the automobile industry in 1900 as engineer and designer for the newly organized National Motor Vehicle Co. of Indianapolis. Later he became vice president and chief engineer of that organization and put the first 6-cyl passenger car on the American market.

Following many years of active consulting work in association with important automobile manufacturers during the late '20s and early '30s, Col. Wall began to retire from active practice and, in 1935, made an extended business and pleasure trip through the Orient. In 1938, he resigned as a member of the Contest Board of the American Automobile Association, explaining that he wanted his place to be filled by someone who would be more active in the work of the Board.

Late in 1938 he was thrown from his saddle and severely injured while breaking in a young riding horse.

Following Col. Wall's death, services were held in Indianapolis and in Boyds, Md. Col. Wall is survived by his wife, Helen M. Wall.

About SAE Members

E. R. STETTINIUS, JR., director of the division of priorities of the Office of Production Management, has been named chairman of the new Priorities Board, established by Executive Order creating the OPM. **WILLIAM S. KNUDSEN,** director general of the OPM, has been appointed an ex-officio member of the Priorities Board. The Board will serve in an advisory capacity to the OPM.

T. P. WRIGHT, vice president, Curtiss-Wright Corp., has been appointed to serve the Office of Production Management as associate director of aircraft production. His activities in this post start Feb. 1. Mr. Wright has been active in the Society for a number of years, both as an officer and technical committeeman. More recently he has helped to develop SAE cooperation with Government and industry agencies in the national defense program.

P. W. LITCHFIELD, chairman of the board of Goodyear Tire & Rubber Co., will head the Goodyear Engineering Corp., a newly formed Goodyear subsidiary which has undertaken a contract for the management and operation of a huge powder-bagging plant for the Ordnance Department of the U. S. Army. Mr. Litchfield has announced that national defense activities of the new company will be independent of the Goodyear company's tire and rubber manufacturing and sales activities.

GARDNER W. CARR, former vice president and general manager of the Glenn L. Martin Co., and more recently in charge of production control for the Lockheed Aircraft Corp., Burbank, Calif., has been appointed British contract coordinator in charge of the entire administration of British contracts with Lockheed.

MAJOR ARTHUR H. DENISON, specialist, U. S. Army, having graduated from the special August-December 1940 course at the Army Industrial College, Washington, D. C., has been transferred to Wright Field, Dayton, Ohio, and assigned to inspection duty.

EDWIN A. ROSS, formerly on the faculty of San Diego State College and director of the San Diego Technical Institute of Aeronautics, has been named associate professor of industrial education in charge of aeronautics at Santa Barbara State College, Santa Barbara, Calif.

FRANK W. CALDWELL, director of research, United Aircraft Corp., East Hartford, Conn., has been elected president of the Institute of the Aeronautical Sciences. SAE members elected vice presidents of the IAS are **WILLIAM A. M. BURDEN,** National Aviation Corp.; **CHARLES H. COLVIN,** U. S. Weather Bureau; **HALL L. HIBBARD,** Lockheed Aircraft Corp.; **PHILIP G. JOHNSON,** Boeing Aircraft Co.; and **LESTER D. GARDNER,** who was elected executive vice president. **GROVER LOENING,** consulting aeronautical engineer, was elected treasurer.

Honored by King

Albert George Elliott

The rank of Commander of the British Empire recently was conferred by King George VI upon Albert George Elliott, chief engineer of the Aero Division of Rolls-Royce Ltd., manufacturers of the engines which power England's "Hurricanes" and "Spitfires." Mr. Elliott has been a Foreign Member of the SAE since 1925.

EDWARD B. NEWILL, from 1930 to 1937 chief engineer of the Frigidaire Division of General Motors Corp., and since that time assistant general manager, has been made assistant to E. R. Breech, vice president of the corporation.

LT.-COM. HENRY JAMES WHITE has returned to the U. S. Navy on an active duty status, and is stationed at the U. S. Naval Air Station, Naval Operating Base, Norfolk, Va. He formerly represented Lockheed Aircraft Corp. in South America.

Commenting on the new graduate program in aircraft production being offered by the New York University's College of Engineering, **DR. ALEXANDER KLEMIN,** director of the college's Guggenheim School of Aeronautics, stated that it is vital to have the aircraft industry apply the general production principles of the automotive industry in obtaining an ever-increasing supply of aircraft. **E. V. FARRAR,** Wright Aeronautical Corp., is one of the outside lecturers from industry that will assist in presenting the course material.

On Jan. 15, **HENRY FORD** formally presented a Naval training school to the United States Navy. "During this crisis," he said, "our organization wants to do everything possible to help America and the President. The Navy being our first line of defense, I feel that the training of these young men will vitally benefit the nation. And, when the crisis is over, we can reclaim these mechanically-trained young men in our industries." The school, which is located on the grounds of the Ford River Rouge plant, will train young naval recruits for technical and mechanical assignments with the fleet and at its bases.

C. B. JAHNKE has been elected president and a member of the executive committee of Cooper-Bessemer Corp., Mt. Vernon, Ohio. He continues as general manager of the company, a post to which he was appointed in 1938. Earlier, he was chief engineer.

ROBERT EARL ROY is senior engineering aide in the United States Engineer Office, Los Angeles. He formerly was a consulting engineer in that city.

JOHN P. GATY, vice president of the Beech Aircraft Corp., Wichita, Kansas, has been named general manager of the organization.

WILLIAM H. POWELSON, for the past several years general shop foreman for the Cleveland Interurban Railroad Co., has taken the post of superintendent of equipment with the Indiana Service Corp., Fort Wayne, Ind.

NORMAN E. MILLER, who has been research engineer in charge of experimental laboratories and new development work for Vickers, Inc., Detroit, since 1935, has been named president of Norman E. Miller & Associates, a recently organized Detroit firm of consulting hydraulic and mechanical engineers. Before joining Vickers, Mr. Miller had been associated with Ex-Cell-O Corp., Cadillac, Lincoln, and Packard.

LEROY V. CRAM, who was resident engineer with Chevrolet, has joined the Allison Division of General Motors Corp., Indianapolis.

HARRY J. CARMICHAEL, heretofore vice president and general manager of General Motors of Canada, Ltd., on Jan. 10 resigned that post to assume a key position in the wartime mobilization of Canadian industry and become what has been described as the "Knudsen of Canada." Relinquishing command of the four large factory plants of General Motors of Canada, Ltd., at Oshawa,

Important War Assignment

Harry J. Carmichael

Windsor, St. Catharines, and Regina, Mr. Carmichael assumes production responsibilities as wide as the whole industry of the Dominion, it was announced by **R. S. McLAUGHLIN,** president of the Canadian corporation.

N. H. F. OLSEN, who was experimental engineer with Ford Motor Co., has been president of the Hexagon Tool & Engineering Corp., Dearborn, since its incorporation in November.

G. I. PARRISH is in the tool engineering department of Douglas Aircraft Co., Santa Monica, Calif. He previously was secretary-treasurer of the Bondall Co., St. Louis, Mo.

EDWARD WARNER recently was reappointed a member of the Civil Aeronautics Board by President Roosevelt.

W. B. BIRREN, former supervising service engineer, Wright Aeronautical Corp., has been appointed service manager of the company. Mr. Birren originally joined the engine division of the Curtiss organization in 1917. Subsequent posts have included an assignment to South America, as well as those of Western representative of Curtiss Aeroplane & Motor Co., and Western service manager of Wright Aeronautical Corp.

W. B. Birren
Advanced

E. C. PINSENSCHAUM, formerly with Timken Roller Bearing Co., Canton, Ohio, is engineer-designer with the B. F. Goodrich Co., Akron.

FRED J. BOLL, who recently completed the Lockheed Aircraft Corp.'s aeronautical engineering course at California Institute of Technology, conducted for experienced engineers from other fields, has been named supervisor of production process, chemical, and metallurgical research, three of the six divisions now housed in the newly-completed Lockheed Engineering Laboratories.

ALBERT FRANK FABER, JR., formerly test engineer, Pratt & Whitney Aircraft, has been advanced to production engineer.

GEORGE B. UPTON, professor of automotive engineering, Cornell University, is author of " 'Synchronizers' in Gear Transmissions of Automobiles," a bulletin explaining, with the aid of drawings and mathematical equations, the mechanical operation of "balking elements" and other modern elements in transmission design. The Cornell University College of Engineering at Ithaca, N. Y., offers single copies of the bulletin without charge to members of the Society of Automotive Engineers. Additional copies will be furnished at the regular price of 40c. The bulletin is published by the Cornell Engineering Experiment Station.

JOHN A. SAVAGE, formerly with the Hoffman Beverage Co., is with the Tide Water Associated Oil Co. as assistant to T. L. Preble, supervisor of automotive transportation.

New GM President

Charles E. Wilson, who has been acting president of General Motors Corp. since William S. Knudsen retired to assist in the national defense program, was elected president of the corporation at a meeting of the GM board of directors held early in January

T. L. PREBLE, Tide Water Associated Oil Co., has been elected eastern district vice president of the National Council of Private Truck Owners, Inc. SAE members appointed to the association's board include **FREDERICK C. HORNER,** consultant to the National Defense Advisory Commission and assistant to the chairman, General Motors Corp., and **LEO HUFF,** Pure Oil Co.

ALFRED M. NEY, who spent about a year and a half in France representing Pratt & Whitney Aircraft and acting as technical adviser to the French Air Ministry, has returned to this country and is located at the company's headquarters in East Hartford, Conn. He left France right after the final collapse of the country and returned to America via Spain and Portugal.

EDMUND B. NEIL, formerly associated with N. W. Ayer & Son, Inc., as mechanical engineer and technical writer, is now a member of the staff of Denham & Co., Detroit, industrial publicity and advertising agency.

JOHN W. BRUSSEL, who formerly was factory manager of the Bendix Products Division of Bendix Aviation Corp., South Bend, has been named president and general manager of Steel Materials Corp., Detroit.

WILLIAM C. GOULD, who was vice president of the Glitter Products Sales Co., Essex, Conn., is sales engineer with the Wright Aeronautical Corp., Paterson, N. J.

Canadian SAE Members Active in War Posts

More news covering parts played by Canadian Section members in war work has reached SAE Headquarters. The majority of the Section's members are engaged in the manufacturing of war supplies; some have acted on various temporary committees working in conjunction with the Canadian Government. Mentioned in the notes below are members who are directly in the Army or in Government war-time posts, whose activities have been reported to the Society.

James I. Simpson, president, Dunlop Tire & Rubber Goods Co. of Canada, Ltd., is a director of Small Arms, Ltd., a government war industry, of which Section Past Chairman **Neil Petersen,** general manager, Canadian Acme Screw & Gear, Ltd., also is a director. **J. C. Armer,** vice president, Dominion Forge & Stamping Co., Ltd., another past chairman of the Section, is chairman of the Armament Forging Die Committee. **Frederic R. Barker,** consulting development engineer, and **Claude E. Wright,** engineer in charge of production, Ontario Steel Products Co. Ltd., have joined the Department of Munitions and Supply. **James G. Morrow,** metallurgical engineer, Steel Co. of Canada, Ltd., is a member of the Canadian Government's War Steel Board.

Wallace R. Campbell, president, Ford Motor Co. of Canada, Ltd., at the outbreak of hostilities, was appointed chairman of the War Supply Board. He served in that capacity until the Board was made a government department.

Attached to the Department of National Defense on technical work are: **N. C. Millman,** product service manager, General Motors of Canada, Ltd., who is SAE Councilor-elect and a vice chairman of the Section; **P. B. MacEwen,** field engineer, Ethyl Gasoline Corp., and **C. W. Kirkpatrick,** auto engineer, Sun Oil Co., Ltd., who is in England with the Department. **Major Max M. Evans,** Ontario Regiment Tanks, has been seconded to the Department on technical work. Major Evans is a past chairman of the Section and was sales engineer with Imperial Oil Co., Ltd.

W. Eric Harris, resident manager, Electric Auto-Lite, Ltd., is a major in the Royal Canadian Artillery, and **Gordon McIntyre,** manager, technical service division, Imperial Oil, Ltd., is a commissioned officer in the Royal Canadian Engineers. **G. M. Gossage,** Aluminum Co. of Canada, Ltd., is serving in the Canadian Army Service Force as lieutenant in the Royal Regiment of Canada.

Major C. A. Choate, formerly instructor, department of motor mechanics, Provincial Institute of Technology and Art, Calgary, Canada, is officer commanding the 13th Field Company, Royal Canadian Engineers, C. A. S. F.

Many of these men have been granted leave-of-absence by their companies, some are serving in dual capacities, and others have given up their civilian posts to serve Canada.

RICHARD SIMONSEN, managing director of Mason & Simonsen Ltd., automotive engineers, Perth, Australia, has been appointed senior ordnance mechanical engineer for the Australian Western Command Military Forces.

JEROME A. CHURCH has joined the Frigidaire Corp., Dayton, as tool designer. He formerly was laboratory technician with the B. F. Goodrich Co., Akron.

EDWARD WINSTON WINEGARD, who was assistant sales manager with Superior Body Co., Lima, Ohio, has joined General American Aerocoach Co., Chicago, as sales representative.

EUGENE LAAS, formerly at the U. S. Naval Engineering Experiment Station, Annapolis, Md., is now affiliated with the Chandler-Evans Corp., South Meriden, Conn.

"Detroit – 1940," an article by **W. F. SHERMAN,** Detroit editor of *The Iron Age* and SAE Journal field editor for the Detroit Section, was among the items sealed in the cornerstone of the Rackham Educational Memorial Building, Detroit, which was laid on Dec. 20.

HOWARD K. GANDELOT, formerly automotive engineer and technical consultant with N. W. Ayer & Son, Inc., is now affiliated with the General Motors Corp.

CAPT. H. M. CRONK, Wright Field, has been elected secretary of the Air Reserve Association.

REGINALD V. WOOD is works manager, aircraft parts division, National Motor Springs Pty. Ltd., Sydney, Australia. He formerly held the same post with Tool Equipment Co., Pty. Ltd., also of Sydney.

Eugene Laas
New Post

BEN CLAFFEY, General Malleable Corp., Waukesha, Wis., is a member of the committee in charge of arrangements for the fourth Annual Foundry Conference to be held in Milwaukee, Feb. 20 & 21, under the joint auspices of the Wisconsin Chapter of the American Foundrymen's Association and the Department of Mining & Metallurgical Engineering of the University of Wisconsin.

HENRY C. PARSONS is engineer with Vicker's Inc., Detroit. He previously was engineer with the Parsons Co. of the same city.

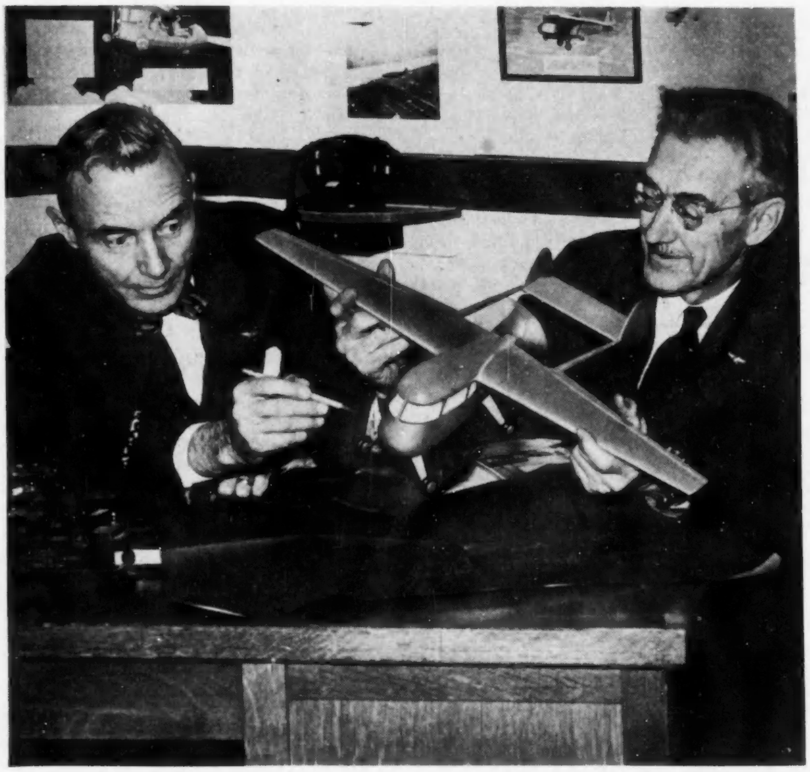
KURT A. BEIER, who has been special design engineer with the White Motor Co., Cleveland, recently joined the Schwitzer-Cummins Co., Indianapolis, as chief engineer.

H. E. BLANK, JR., formerly assistant editor of *Automotive Industries,* is technical editor of *Modern Industry,* a new magazine published by Magazines of Industry, Inc., New York. The first issue is scheduled to appear Feb. 15.

NELSON G. KLING is designer with the aircraft division of Electrol, Inc., Kingston, N. Y. He previously was chief designer with Fairchild Aviation Corp., Jamaica, N. Y.

LES CARROLL, SAE Journal's eastern advertising manager, has been elected president of the Scarsdale, N. Y., Safety Council for 1941. Mr. Carroll has been active in community traffic safety work for many years and has been a member of the Council since its formation three years ago. Serving on the Council for 1941 are three other SAE members: **DR. MILLER McCLINTOCK,** director, Yale Bureau for Street & Traffic Research; **DAVID BEECROFT,** Bendix Products Division, Bendix Aviation Corp.; and **EDWARD GRAY,** Ferodo & Asbestos, Inc.

Les Carroll
Heads Safety
Council



Ralph Upson (left), consulting mechanical and aeronautical engineer, and William B. Stout examine a model of the Stout Skycar, designed under the direction of the latter. The airplane, known as America's "first flying automobile," will have four wheels and steer like a car. It will be powered by a 100-hp engine, have 4-wheel brakes, and a cruising speed of 120 mph. Use of four wheels will permit the landing gear to be put near the cabin, reducing wind drag to a minimum. The cabin will seat two passengers

Arthur A. Skinner

Arthur A. Skinner, long affiliated with the Leece-Neville Co., Cleveland, of which he was general sales manager, died Dec. 15 at the age of 55. He became an Associate Member of the Society in 1923, and transferred to Member Grade in 1929.

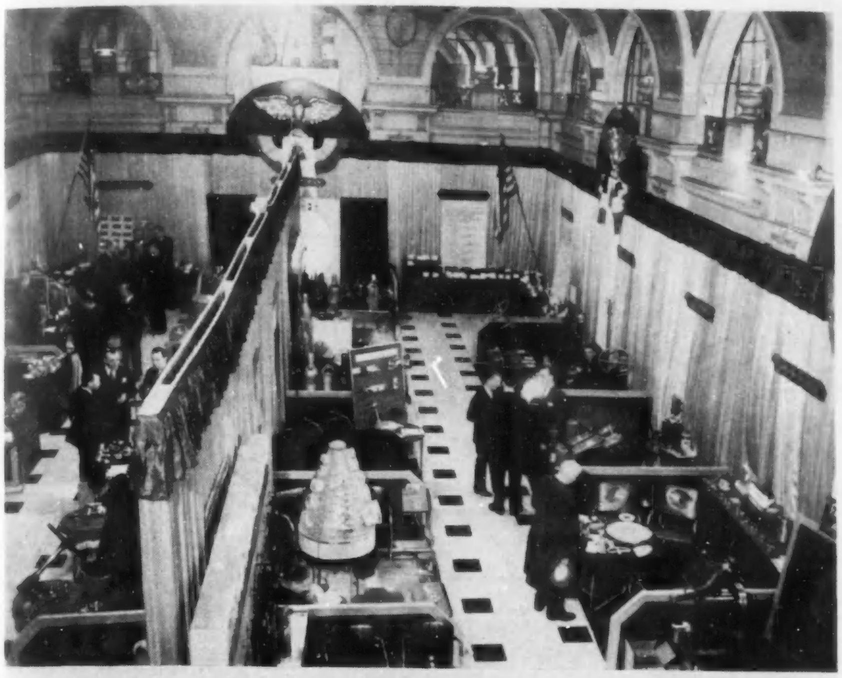
In December, 1913, Mr. Skinner joined the Leece-Neville Co. as sales engineer. He continued with that company until his death, advancing to the post of general sales manager. During his years with the company, Mr. Skinner combined with his sales and executive duties consulting work on the application of starting motors and generators for automotive purposes. He also designed mounts and drives for automotive mechanical units.

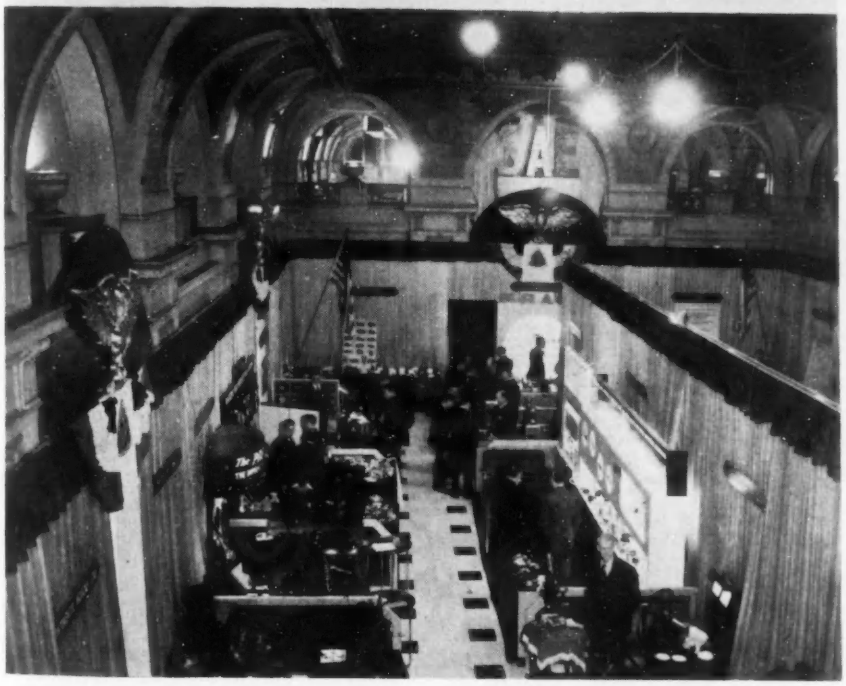
Edgar T. Bomer

Edgar T. Bomer, draftsman with the Lockheed Aircraft Corp., Burbank, Calif., who became a junior member of the Society in July of last year, died Dec. 2, as the result of an automobile accident.

Mr. Bomer received his M.E. degree from Rensselaer Polytechnic Institute with the Class of '36. Before joining Lockheed, he was mechanical designer with the Transducer Corp., New York, in charge of mechanical design of communication and other special electrical acoustical equipment. Mr. Bomer was 27 years of age.

ENGINEERING DISPLAY





INNOVATIONS were plentiful at the Annual SAE Engineering Display and they received a deserved quota of attention by members and guests of the Society who attended the 1941 Annual Meeting. Parts, materials, metallic and non-metallic products, instruments, lubricants, tools, and a variety of equipment were among the items which contributed to the display. Many of these products were seen for the first time. Other parts and devices on display have been developed and improved over a series of years.

AIR REDUCTION SALES CO. displayed some new items, such as flame de-scaling and flame gouging tips, a new welding rod with a flux coating and non-fuming characteristics, and several manuals on welding practice both with flame and with arc equipment. The manuals are intended for vocational schools including those operated in connection with Government enterprises. Other equipment exhibited was for flame hardening, other industrial processes requiring gases supplied by the company, and products needed in welding.

ALUMINUM CO. OF AMERICA'S impressive display included many new sand castings in aluminum for liquid-cooled 12-cyl aircraft engines. Also shown were other sand castings; aluminum and magnesium-alloy forgings for aircraft parts; aluminum and magnesium permanent and semi-permanent mold castings, including airplane wheels; many fine examples of aluminum and magnesium-alloy die castings; several new extruded shapes in aluminum, including some with five holes and some with internal and external radial fins; press forgings in

aluminum, including one for a large air-compressor valve; and a new form of plain bearing for slow-speed engines having hardened crankshafts. These bearings are made in a permanent mold from a new alloy. Among other new developments shown is a new type of Alumilite finish in which a pigment, rather than a dye, is employed to give a finish resembling enamel.

ALUMINUM INDUSTRIES, INC., exhibited a variety of its products, the greater part being castings made in aluminum alloys, some in sand and some in permanent molds but, for the first time, several magnesium-alloy sand castings, chiefly for aircraft parts, were featured. One of the largest aluminum sand castings was a diffuser for a Wright engine supercharger. Smaller castings included pistons both for engines and for hydraulic-brake applications as well as some non-automotive parts. Permite Diachrome poppet valves were among steel parts displayed.

AMERICAN BOSCH CORP. had a diversified display including many numbers in its lines. Among these were new 7- and 14-cyl aircraft magnetos and representatives of the older "MG line" of magnetos of more conventional form. A new electric windshield wiper for 6- and 12-v circuits and a new 500-w radio-shielded generator for buses and trucks also were shown, as was, too, the Bosch line of diesel injection pumps. A new feature available on the latter line is a governor for pump speeds varying from 400 to 1200 rpm. The Bosch oil filter was also in the display.

BAKELITE CORP. was the only manufacturer of plastics having a display, and in it were included all important types of plastics in common use, among them some types not made either by Bakelite or by Carbide and Carbon Chemicals Corp. of which Bakelite is now a part. Of special interest was the "Plastics Comparator" showing the relative order of merit of the different plastics under different properties or headings. Another feature of the display was a chart indicating that the number of plastic parts used in passenger cars has increased from 1 in 1915 to some 125 this year. Special emphasis was placed on the polystyrene type of plastics now said to be the least expensive thermoplastic (per piece) of any in common use.

CITIES SERVICE OIL CO. presented for the first time improved forms of the "Powerprover" and some innovations in other instruments, especially for sampling and testing gas. Powerprovers shown include types for portable use, both with bulb and with pump aspirators and containing batteries. Some had recharger equipment, and one type, for engine test stands, was arranged so that as many as nine samples can be taken simultaneously for distribution indications. An oil heater for aircraft engines was shown which has an automatic thermostatic control. Other instruments included an "Airprover," for measurement of combustible gas in air, and a "Heatprover" for controlled atmosphere furnace tests.

CLEVELAND GRAPHITE BRONZE CO. showed the many forms of bearings, bushings, and clutch plates which it supplies, featuring among them the "Micro" type of bearing which has a steel back with a high-tin babbitt lining 0.002 to 0.0045 in. thick. The clutch discs, some of which go into tank applications, have bronze powder sintered onto the faces, which are subsequently ground. One of the bushings shown has a heavy steel back with a copper-lead lining in which the total wall thickness is held within 0.00025-in. limits, the bushing being a floating type used in steering knuckles of passenger cars.

CONTINENTAL MOTORS CORP. showing this year for the first time, featured three of its many types of engines, some of which figure in the Government aircraft program. One of the latter shown is a 7-cyl aircooled radial engine known as model W6-70. It is being used in both Army and Navy training planes and in tank applications. The other aircraft engine shown is a 4-cyl opposed type available in 50, 65, 75 and 80-hp sizes. It is available both in carburetor and injection types. For truck, industrial, and marine applications, there was shown a new "M-600" series, 6-cyl engine of fairly conventional type.

DE LUXE PRODUCTS CORP. featured its line of oil filters. One filter was shown in operation discharging cleaned oil over a ground glass globe with a light inside and, beside this globe, was a second one with dirty oil flowing over it for a comparison. Some visitors to this booth showed keen interest in a "sump bottle" containing oil, sediment, and water. When inverted, this bottle shows clearly how sediment separates by flowing slowly downward while clean oil rises to the top, somewhat as in the company's absorption filter.

DOEHLER DIE CASTING CO. featured a display of die castings including a central "backdrop" of large grilles, hood panels and instrument panel parts, each handsomely plated over the zinc alloy. Also shown was a variety of other castings in the same alloy, some unfinished and some in unusual bronze and green finish. There was, too, a representative display of aluminum-alloy die castings, some being automotive (especially automatic-transmission valve parts), and some for non-automotive uses. Several extremely light magnesium-alloy castings were in evidence, but mostly for other than automotive uses. Finally were shown a large group of brass die castings, mostly small parts in which strength greater than that of the other alloys or a special type of corrosion resistance is needed.

EX-CELL-O CORP. had a display which included a large line of diesel

fuel and gasoline injection nozzles, among them some of smaller size than shown formerly. Certain of these products are suited for use on aircraft engines. All include filters, some of the metal-edge type and some Moraine porous bronze, incorporated in the body of the nozzle. Also shown were complete Ex-Cell-O injection pumps and parts and a board on which all parts of a fuel-supply system for a Dodge Lanova-type diesel were mounted.

FABRISTEEL PRODUCTS, INC., featured in its display "Fast-on Clinch Nuts" which are produced from flat wire having a stepped edge. The nuts are for clinching in square holes in sheet stock, using a special magazine feed press which carries a tool that strikes the corners of the nut, peening them over so that the nut remains attached to the sheet. The showing included actual applications, chiefly to body parts, for Dodge, Ford, Chrysler, Briggs, Budd, and Dura. These parts included a floor pan, fender shield, striker and door parts. Applications at rates as high as 2500 per hr are said to be attained.

FRAM CORP. featured in its exhibit a display showing the filtering of dirty oil through waste samples, one chemically treated and one not so treated. The former, as used in filters of this make, showed marked superiority. Among the filters displayed was a new type designed to filter diesel fuel. It includes stages for both mechanical and chemical filtration. Another new filter shown was for lubricants used in industrial applications.

GARLOCK PACKING CO. had a table display of many of the sheet and other packing products which it manufactures. New items include rubber tubing and other extruded products, various leather products and grease seals, packing for aircraft hydraulic landing gears, carburetor accelerator pump washers, and the like. Several of these products are made with synthetic rubber, such as neoprene. Some are for Government applications and of a confidential nature. Several molded-rubber or synthetic-rubber products shown were in this category.

GEMMER MFG. CO. repeated, with modifications, its 1940 display in which the central feature was a machine designed to show the input and output of a large truck-type steering gear. This test involves hydraulic loading of the gear and is devised, of course, to show the high efficiency attained in operation. Beside the gear on the test stand, other sizes of steering gear were shown.

HARRIS PRODUCTS CO. featured a variety of new products all of which embody the same principle as that used in rubber bushings for spring shackles. This involves an inner bushing, often in brass or bronze, outside of which is a bushing of rubber under considerable pressure, confined between the inner bushing and an outer one of steel. Such bushings are now widely used for other purposes than in spring shackles and especially where a degree of flexibility is needed either in torsion or radial load, or both. The rubber gives, beside flexibility, insulation against shock and vibration, and is now used in gear hubs, tractor wheels, clutch release shafts, radius rods, and the like. Gogan machines for durometer and deflection tests of the rubber bushings also were included in this exhibit.

HERCULES MOTORS CORP. presented a display of diesel engines having from 2 to 6 cyl. One of these engines is a 6-cyl flat type previously shown and two are 4-cyl types designed as Ford and Chevrolet replacement engines, the size being $4\frac{1}{4} \times 4\frac{1}{2}$ in. All except the 2-cyl engine shown were equipped with Bosch fuel-injection equipment.

JAM HANDY ORGANIZATION featured in its display sets of films for still projection designed for use in technical training of student pilots, automobile mechanics, and others requiring similar instruction. These films are supplied with projection equipment and some have been worked out with the approval or cooperation of Government bureaus and are intended for defense training purposes.

KOPPERS CO. through its American Hammered Piston Ring Division, confined its display to piston rings which are offered this year with a Van der Horst porous chrome plating. This plate provides a highly wear-resistant surface and one which, being porous, absorbs and holds an oil film. The deposit is honed after application, the honing leaving a smooth surface without removing the plate. Rings shown included many sizes and those for diesel as well as for carburetor engines.

LINK ENGINEERING & MFG. CO. confined its display to testing and inspection instruments, laying special emphasis on a new form of compression and deflection tester for rubber which a committee, in which the SAE is represented, is said to have standardized. Also exhibited was a piston-ring tester recently improved by the addition of an electronic control for flashing lights at critical points on the scale. Spring testers of earlier designs were also among those offered.

MONROE AUTO EQUIPMENT CO. featured a new 2-in. size of direct-acting shock absorber for trucks and similar vehicles, the design being the same as that for a larger and a smaller size shown this year as well as in 1940. Beside this product were displayed several shapes of sway bars, shifter and remote-control rods, rear-axle struts, jacks, and tools for tire removal. One tool is supplied for cars in the Chrysler line to facilitate removal of tires from the new form of rim which these cars employ.

ROSS GEAR & TOOL CO. showed several of its steering gears, the new-

est of these being one designed for four-wheel steering applications. This has two drag-link arms, each with a sector stud on a common worm. Also new is a tractor wide-angle gear with 140-deg travel. This gear makes use of a sector plate having four studs which contact the worm successively.

PRESTOLE DEVICES DIVISION, DETROIT HARVESTER CO. showed many recent developments in fastening devices some of which involve clips or "Quickies" used in place of nuts or similar fastenings and some of which make use of "Prestoles" a special form of hole, the edge of which constitutes a thread formed directly in stamped or drawn parts. Certain of these fastenings are made in tempered spring steel and others in unhardened strip, the latter in some cases being spotwelded in place and, in others, arranged to clip over the edge of sheet in which a plain hole is punched. All these fastenings facilitate rapid and inexpensive assembly.

SPICER MFG. CORP. devoted its display mostly to parts that it is making in the rearmament program, including a steering differential with band brakes, transmission gears, spiral-bevel gears, synchronizers, and axle parts for tank applications; and a rear axle for light reconnoitering cars. Also shown were parts for a three-stage turbine torque converter and fluid coupling parts suitable for bus applications. These parts were supplemented by universal joints with shafts, such as are standard on many vehicles.

STEWART-WARNER CORP. presented a diversified exhibit of instruments and accessories. These included panels of marine instruments, gages of various types, several adaptations of speedometer designs, and a group of Alemite lubrication fittings. Also shown was a windshield with a working model of an electric windshield wiper and a model showing an electric fuel pump in operation. Another stand had a Hudson instrument panel with several instruments and a radio mounted thereon.

TINNERMAN PRODUCTS, INC., devoted its display to scores of types of speed nuts and clips, including many which have not been shown before. Among the latter are such items as: a trough-shaped clip for fastening U-shaped rolled sections to the Cadillac die-cast grille; a nut with spanner holes for fastening the Chevrolet brake drum to its flange prior to application of wheel nuts; several sizes of cable-supporting clips with a "heel-and-toe" projection to snap into punched holes, as in dash panels; special clips for forming a concealed hinge for light doors and a "blackout" clip with flexible prongs to fasten metal to window panes, the clip attaching to the leg of T-bars forming parts of the window frame. Many ingenious new forms of clips for radio and other non-automotive applications also were shown.

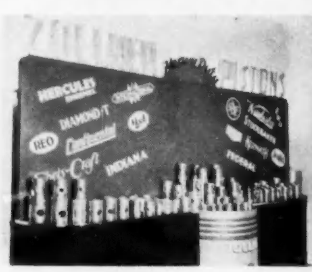
TORRINGTON MFG. CO. a newcomer to this exhibit, showed a line of stamped fans and squirrel-cage blower rotors which it manufactures in large quantities. Many of these products are used in passenger-car heating systems, some being applied to under-seat heaters and some to dash types. Others are suited for air-conditioning systems and space heaters for industrial applications and some for gun-type oil burners, etc.

VICTOR MFG. AND GASKET CO. displayed a large line of gaskets and oil seals. Among the newer types were: a soft aluminum sheet-stock gasket for oil pumps and similar aircraft use; a thin (0.020 in.) copper-asbestos gasket for gasoline engines and one 0.040 thick for diesel engines; a Victoprene oil seal used especially for torque converters; asbestos gaskets bonded with Victoprene, stamped to shape and afterward again treated with Victoprene to seal edges; and special shapes of Victoprene waywipers for use on machine tools.

WAUKESHA MOTOR CO. confined its exhibit to the latest form of CFR engine for aviation type testing. This is similar to the regular CFR engine in many respects but is designed to run at speeds up to 3000 rpm although regularly used at 1200 rpm. Counterweights are provided to eliminate the rocking couple. A thermocouple, which is more sensitive than a bouncing-pin indicator, is used in place of the latter and in combination with a potentiometer. The condenser for steam generated in cooling is enlarged as compared with that on the earlier design.

ZOLLNER MACHINE WORKS presented a large showing of aluminum-alloy pistons which are supplied to numerous makers of engines and vehicles. These pistons incorporate what is termed a "cantilever" skirt section and involve a special form of cam grinding. Types are included for gasoline engines and for many makes of diesel engines, both four-cycle and two-cycle, among these being pistons for Waukesha-Hesselman, International Harvester, Mack-Lanova, Buda, GMC, and other makes. Small pistons for outboard engines were shown.

Some exhibit spaces not devoted to commercial displays were given over to a large showing of SAE-Quartermaster Corps standardized products on which members and committees of the Society have worked.



Reports of Committees

Meetings Committee Report

FOR the 1940 administrative year, the meetings program of the Society consisted of nine meetings exclusive of regular Section meetings and regional meetings.

General arrangements for the Annual Meeting and the Summer Meeting were in charge of the Meetings Committee, and the technical sessions at these meetings were handled mainly by the respective Professional Activities, which were also responsible for the management of the technical meetings other than the Annual and Summer Meetings. All arrangements for the Annual Dinner were under the general supervision of the Meetings Committee.

The Engineering Display at the Annual Meeting and at the National Aircraft Production Meeting again furnished the various companies an opportunity to exhibit new products and to present interesting technical information to the engineers attending.

All of the National Meetings of the 1940 administrative year were characterized by an emphasis on National Defense with the appearance of key officers of the U. S. Army and Navy throughout the year, as well as many technical sessions devoted to problems related to this timely subject.

The Summer Meeting marked the 35th Anniversary of the Society. Preparedness was the dominant theme of the meeting, and the role of the Society in National Defense was emphasized especially in a stirring address by Lt.-Col. E. E. MacMorland. Noteworthy throughout the meeting was the attendance of military officials who participated in the technical sessions. One of the many important features of the meeting was an exhibit of U. S. Army Ordnance equipment.

The Annual Dinner again sounded the note of preparedness with a talk by the Hon. Robert P. Patterson, Assistant Secretary of War, on the part of the industry in National Defense.

The Meetings Committee takes this opportunity of thanking the Sections which rendered such excellent assistance in connection with the meetings held in their respective territories, namely, Detroit, Milwaukee, Northern California, Northwest, Oregon, Pittsburgh, Southern California, Southern New England, Washington and the Tulsa Group.

RALPH R. TEETOR, *Chairman*

Meeting	Place	Date	No. of Sessions	No. of Papers	Attendance
Aeronautic	Washington, D. C.	March 14-15	7	14	273
Transportation & Maintenance	Pittsburgh, Pa.	March 28-29	6	5	234
Production	Hartford, Conn.	May 7-8	4	6	133
Summer	White Sulphur, W. Va.	June 9-14	13	28	635
Tractor	Milwaukee, Wis.	Sept. 24-25	5	6	426
Annual Dinner	New York City	Oct. 14	1	1	967
Aircraft Production	Los Angeles, Calif.	Oct. 31-Nov. 2	7	15	969
Fuels & Lubricants	Tulsa, Okla.	Nov. 7-8	5	9	151
Annual Meeting	Detroit, Mich.	Jan. 6-10, 1941	22	46	(1959)*

*1940 Annual Meeting attendance.

Publication Committee Report

THE most conspicuous change in the Journal during the past twelve months has been the modernizing of the typography and layout, together with the development of a new cover design. These changes, which were made under the direction of the Executive Editor, took full effect with the issue of July, 1940, and received favorable comment from members of the Society. It is pleasing to report also that the change brought outside recognition in the form of an award of merit to the Journal for editorial achievement – "for the greatest improvement in format and appearance" – in the annual competition conducted by Industrial Marketing.

In addition to these physical changes, continued progress has been made in developing the sections' reports into technical news summaries which provide a monthly record of engineering progress in the industry. The Transactions Section has been expanded somewhat and the scope and variety of articles published have been extended. Naturally, considerable space has been devoted to recording and interpreting the increasingly widespread participation of the Society in national defense activities.

The Section field editors have been encouraged to include with the technical summaries of Section Meetings, such items concerning the personal activities of members as seem likely to be of interest to the Society at large. During the calendar year of 1940, 873 pages of text and 496 pages of revenue advertising were published in the Journal. Of the text pages, 552 consisted of papers and discussion published in the Transactions Section. In addition, 33 pages of technical articles were published outside the Transactions Section. Thus 67% of the total editorial content consisted of technical articles. Published also were 13 pages of general articles dealing with special phases of national defense and other Society activities. An Index was published as usual, and for 1940 it ran 44 pages in length. During the preceding year, 1939, 842 pages of text and 422 pages of revenue advertising were published.

Fifty-two complete papers, some with discussion, were published during the year 1940.

Transactions

Transactions of the Society were brought up to date by publication about the middle of January of Volume 34 covering the year 1939. In this volume there were 548 pages. It contained 67 complete papers and discussions.

Volume 34 was sold to members for $2, the charge being entered upon the bill for annual dues.

Roster

The SAE Roster for 1940 contained 11 more pages than the 1939 edition. Names of members on our Reserve Membership List are not included.

The Roster for 1941 will be issued about the middle of February.

STANWOOD W. SPARROW, *Chairman*

Membership Committee Report

THE gratifying growth in membership for the calendar year 1940 is the result of the splendid cooperative spirit in membership endeavors of the National and Section Membership Committees and individual members of the Society.

The following comparative membership statistics are submitted:

	1939 (as of Dec. 31)	1940 (as of Dec. 23)
Members	3138	3316
Associates	1594	1665
Juniors	496	609
Foreign Members	400	369
Service Members	98	109
Departmental Members	7	7
Affiliate Members	79	83
Additional Affiliate Member Representatives	49	65
	5861	6223
Enrolled Students	399	512
	6260	6735

Applications received Jan. 1 to Dec. 31, 1939 – 778

Applications received Jan. 1 to Dec. 23, 1940 – 1051

The Committee is deeply grateful to all those who have given so willingly and generously of their time in assisting us.

AUSTIN M. WOLF, *Chairman*

Standards Committee Report

AT the beginning of this administrative year immediately following the Annual Meeting last January, the Chairmen of the Divisions of the Standards Committee were asked to submit their proposed programs for the year. With this as a basis, together with the projects then in progress in the several Divi-

tions and those that have been initiated since, the Standards Committee has had an active and productive year. Thirteen of the 19 Divisions and seven of their Subdivisions held 24 Division and 10 Subdivision meetings, including two Division meetings at this Annual Meeting. The accumulative attendance at these meetings was about 460 members and guests from all branches of the automotive and associated industries, and on the basis of an average of five working hours at each meeting, this represents over 2300 man hours contributed directly by industry during the year to this important work of the Society.

The general organization of the Standards Committee and its Divisions continued practically the same as previously, with the customary changes in personnel that brought a considerable number of new members to the Divisions. A large part of the initial work under the Divisions, especially on new projects, has been carried on by either permanent or temporary Subdivisions.

A perhaps larger number of projects than during previous years has been completed for adoption or practically completed.

In the aeronautical field, 136 new SAE Aeronautical Material Specifications were completed and published. At the time of preparing this report (Dec. 17) over 113,000 copies of individual specifications have been distributed in complete sets and over 50,000 copies of the specifications have been distributed separately. Distribution was at first restricted by Council action, but this restriction was raised early in the fall. Additional new and revised specifications will be issued as they are completed and released.

Several new and revised standards for aircraft-engine accessory mountings and for parts were completed, and work is still in progress on developing perfected screw thread standards and a new standard for a range of involute splines.

In the general automotive field several new parts standards have been developed and much has been accomplished toward bringing existing standards up to date and discontinuing several that have become obsolete. Particular progress has been made in the field of materials by the development of standard methods for recording non-metallic inclusions in steels and a standard method for recording magnaflux indications. The SAE steels have been revised in some compositions and their numbers reduced by about 25 per cent on the basis of a careful survey in the automotive, machine tool, general machinery and railway fields. Also for the first time, the SAE steels will be classified as primary and secondary on the basis of usage. It is interesting to note that the primary standards, including the classification of the compositions check very closely with a similar survey conducted during the year by the American Iron and Steel Institute from the point of view of the steel producers. A special Subdivision of the Iron and Steel Division is now making a thorough study of the hardenability of steels and hopes eventually to establish a standard method for determining hardenability.

Considerable has also been accomplished during the year on improving the motor-vehicle lighting specifications, revising the standard engine testing forms and providing an up to date and more practical method for establishing automotive parts nomenclature to supersede the old SAE nomenclature. A number of projects are in progress in practically all of the Divisions and as many of these as possible will be completed during the ensuing year.

Cooperation in Other Activities

The Society is continuing to take an active part either jointly with, or by representation on other standardizing organizations, among which considerable progress has been made during the year in the work on mechanical rubber parts in ASTM-SAE Technical Committee A on Rubber, and in the petroleum and metallurgical fields.

Many of the projects in Sectional Committees under the procedure of the American Standards Association that are co-sponsored by the Society or on which it is represented, have accomplished much during the year, particularly in connection with American Standards on Screw Threads, Bolts and Nuts, and in the small tools field. Many of these projects had developed to the point of international consideration, but this phase of these activities has necessarily become inactive under present world conditions.

SAE Handbook

The 1940 edition of the SAE Handbook was somewhat later than usual in distribution in order to include a number of important new standards, particularly in the aircraft field, that were not completed until after the Annual Meeting last year. Perhaps the most notable change in this edition was the grouping of all the specifically aircraft standards together in Section 1, rather than scattering them through all the Sections of the Handbook, depending on the nature of the standard. Historical information in the front colored Section relating to the development of SAE Standards and other data pertaining to the standards were consolidated into a single Section and supplemented by a description of the Society's organization and procedure in developing SAE Standards, and with regard to cooperation in American standardization activities. The Handbook remains otherwise generally the same in form and arrangement as the previous edition.

General

Although conditions in some respects for carrying on standardization work have become much more difficult during the year just past, the urgent need for practical standardization throughout the automotive and related industries has become increasingly recognized and has been a stimulus to a large part of this work. It is the purpose of your Standards Committee to continue this work to a maximum degree, and toward this end the Standards Committee organization has been carefully set up for the ensuing year. It is expected that industry, governmental agencies and others will give increasing support to your Standards Committee's efforts, toward the end that the SAE Handbook may become in itself a standard.

JOHN H. HUNT, *Chairman*

Sections Committee Report

THE Sections are steadily improving in getting their organizations set up early and in making advance plans for their meetings. With very few exceptions, meetings have been planned three and four months in advance, and attendance has been encouraged by sending early notices to members.

From the table below, which gives the various topics discussed at Sections meetings during the past year, it will be seen that a wide variety of subjects was covered. This list of topics refers only to Sections meetings and does not include national meetings. High caliber speakers were secured on technical subjects of timely interest, and it will be noted that there has been a sharp rise in the number of meetings on national defense. This subject has been discussed from a technical standpoint with speakers from the War Department and from the industry covering defense in the air and on land.

National Defense	33
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Fuels and Lubricants	16
Passenger Cars	14
Diesel Engine	11
Social	11
General	10
Inspection Trips	9
Transportation & Maintenance	8
Materials	8
Production	7
Tractor and Industrial	6
Truck, Bus and Railcar	3
Electrical Equipment	3
Bodies	2
Research	2

Committee Work

Each Section was encouraged to appoint a large Membership Committee to assist in membership increase work in its territory with the result that over 500 Membership Committeemen have been functioning successfully throughout the country. The fine meetings held by the Sections are evidence of the effective efforts of the Meetings Committee Chairmen. Reception Committees have fostered good will and good fellowship at Section meetings, and Placement Committees have cooperated with headquarters in the employment problems of their Section members. Lists of approved colleges within the Sections were sent to Student Committee Chairmen and they have taken an active interest in student events in the Section and the Society. Excellent accounts of Section meetings have been sent to the SAE Journal by Field Editors.

St. Louis Section

The Council approved the raising of the St. Louis Section from probationary status to full Section status.

The Tulsa Group

In its third year of operation the Tulsa Group held fine technical meetings and functioned very effectively in membership increase with the result that there has been a healthy growth in membership in this Group. The Group devoted a great deal of time and effort to the staging of the National Fuels and Lubricants Meeting and the success of this meeting was largely due to their fine cooperation.

The Colorado Club

The Colorado Club may look upon 1940 as its most successful year. Meetings were held regularly every month and these increased activities have attracted a healthy attendance.

Student Branches

There has been a considerable growth in interest in student activities, and the eleven Student Branches have been working closely with their Sections. Section officers have cooperated most generously with Student Branches located in Section centers, and

Student Branch activities have been stimulated by this closer tie.

Visits to Sections

During 1940, every Section of the Society has been visited at least once by a National officer or Staff officer of the Society. President Nutt addressed 20 Sections during the year.

There has been definite progress in all Sections during 1940. This can be attributed to the ability and leadership of the men elected to serve on the Section Governing Boards. We take this opportunity to commend these men for their splendid work and fine cooperation.

A. L. BEALL, *Chairman*

Research Committee Report

NINETY-SEVEN committee meetings and numerous informal group conferences were held in the conduct of the Society's Research activities during 1940. These minutes and committee reports required the cutting of 2500 mimeograph stencils.

Aircraft-Engine Lubricants

The Aircraft-Engine Inspection Forms for Radial Aircooled Engines, formulated by the Committee, have been in use for over a year and are now being revised, in the light of experience, and enlarged to include sheets suitable for use with in-line aircraft engines. The use of a small sized engine for testing lubricating oil was discussed at an informal meeting held in November 1940, and the drafting of a form for use in reporting lubricant tests made on single cylinder engines is now in progress.

Looking toward the development of a laboratory method on the Cooperative Universal Test Engine which would give results on aircraft-engine lubricants having a significant relation to full-scale performance, owners of C.U.E. Engines formed a participating group and made available such data as they were willing to contribute for purposes of coordination and as a basis for making recommendations covering operating conditions to be used in aviation oil tests. As an outgrowth of this endeavor, A. L. Beall presented a paper, "A Comparison of C.U.E. Engine Installations," at the Society's Summer Meeting in which he covered the use of the engine for testing oil, fuel, spark plugs, etc. A companion paper covering the design and possibilities of the C.U.E. Engine was presented by A. W. Pope of the Waukesha Motor Co., builders of the engine. Mr. Beall's survey indicated that there are significant differences in equipment and procedure sufficient to seriously affect results, and accordingly the efforts of the C.U.E. Engine Owners Group are now directed toward reconciling these differences between individual laboratory set-ups.

In response to a demand for standardization of a method for determining the efficiency of corrosion preventive materials used in the preservation of aircraft engines and their parts in storage and shipment, the Aircraft Engine Lubricants Research Committee accepted this problem for study with a view toward formulating an acceptable method on the basis of cooperative work. The Subcommittee on Laboratory Methods to which this project was assigned made a survey of current methods and has in progress a program which includes the design and construction of a humidity cabinet for test specimens.

Working in cooperation with Committee D-2 of the American Society for Testing Materials, proposed methods on chloroform and naphtha insolubles have been formulated. The method for determination of neutralization number of used aviation oils, previously developed in the Committee and recommended to the ASTM, has since been reported unsatisfactory in certain instances. Intensive work has resulted in a substitute procedure which is being given trial use to determine its reproducibility and significance. The Subcommittee on Laboratory Methods has been instructed to assemble the various methods, which have been developed by the Committee, into convenient usable form with identification numbers.

Crankcase Oil Oiliness

As the first step in an attempt to correlate the results obtained in oil tests on laboratory wear test machines, 19 laboratories are participating in a cooperative program of tests employing three test oils known to participants by code letter designation only. It is expected that results from these tests will be forthcoming within the next few months.

There has been some difficulty encountered in completing the previous test program, particularly the engine tests, on the "C" and "D" samples, representing a lubricating oil with and without an "unknown" commercial additive. This program was made broad in scope to permit the use of individual equipment and methods of test in determining whether the additive shows any improvement as judged by wear tests. An analyzing group is now considering the data reported by participating laboratories and formulating a report to the main Committee.

Crankcase Oil Stability

Acting jointly with Technical Committee B on Lubricants of ASTM Committee D-2, the Crankcase Oil Stability Research Committee has in progress a cooperative program which provides for the testing of three samples each (of high, intermediate, and low stability) of SAE 20 and SAE 60 oils. The No. 20 oil is representative of the light oil consumed in greatest quantity, while the No. 60 oil is representative of aircraft oil. Over a thousand gallons of oil have been required to fill the orders of the twenty-eight participants.

Extreme-Pressure Lubricants

As a sequel to criticisms of the surface finish of the test cups used with the SAE Extreme-Pressure Lubricants Testing Machine, the Timken Roller Bearing Co. made available test cups carrying a higher degree of finish than that used on the standard cups. Over 1000 such cups were subjected to comparative tests by a group of cooperating laboratories. The results of these tests confirmed earlier indication that the use of the honed finished cups reduces the spread in results obtained on the mild and active types of EP Lubricants.

Early in 1940 it became evident that the present method of test in use on the SAE Extreme-Pressure Lubricants Testing Machine was not properly differentiating between extreme pressure lubricants for passenger cars and for trucks. Accordingly, the Subcommittee on Design was requested to determine what changes would be necessary in the Machine to increase the unit pressure on the test cups, lower the rubbing speed of the test surfaces, and decrease the rpm of the cups to more nearly simulate the conditions of hypoid gears in truck axles. The results of a limited number of tests, in which the loading was increased by the use of narrower cups, were not conclusive and, therefore, a further program of tests under more severe conditions has been undertaken by 17 cooperating laboratories. Over 2000 test cups and 170 gallons of test lubricants have been ordered by participants in this program.

The Subcommittee designated to outline methods of test for the various machines in current use presented to the Committee in June methods for the operation of the Almen, Falex, and Shell 4-Ball machines and promised the procedure for the Timken machine at an early date.

Highways

As a concluding phase in the study of safety in connection with towing devices, tractors and trailers, the Highways Research Committee, with the approval of the General Research Committee, transmitted to the SAE Standards Committee recommended king pin offsets for standardization as recommended practices, and for publication in the supplement to the Handbook.

The study of instrumentation and procedure for measuring tractive effort between tires and the road including nomenclature has been continued by the Highways Research Committee in cooperation with the Highway Research Board of the National Research Council.

A special subcommittee, Dr. H. R. DeSilva, chairman, has collected and analyzed all available definitions of motor vehicle accident and on the background of such information has formulated a definition which has been submitted for comment to over a hundred interested persons outside the Committee membership in the hope that one universally acceptable definition may be the outgrowth.

In response to a request from the Surface Transport Corporation of New York, the Committee has been studying the accident hazard involved in the problem of static charge on vehicle bodies.

Under the auspices of the Highways Research Committee, a demonstration of Army blackout equipment was held for a restricted list of persons in conjunction with the Society's Summer Meeting at White Sulphur Springs. With the approval of the Society's National Defense Committee, the Highways Research Committee is continuing to study the adaptation of blackout lighting equipment for civilian use on the highway.

Ignition

As an outgrowth of test work in individual cooperating laboratories and a series of conferences with cable manufacturers, aircraft engine builders, and airline operators, the Ignition Research Committee adopted a Material Specification for Aeronautic Type High-Tension Ignition Cable, and recommended it, through the General Research Committee, to the Standards Committee for action.

On invitation, C. E. Swanson of Northwest Airlines presented a report to the Committee on an improved type of ignition shielding system. It was so excellently done and so well received that upon recommendation of the Ignition Research Committee a paper, "Supercharged Aircraft-Engine Harness," was presented by Swanson at the Society's National Aircraft Production Meeting at Los Angeles.

Test methods for rating both aircraft and road vehicle spark plugs using pre-ignition

tests in the high-speed, small-cylinder CFR Engine with supercharging and other single-cylinder engines are being investigated, by members of the Committee, in parallel with work on the C.U.E. Engine.

Riding Comfort

Prof. W. E. Lay, member of the Riding Comfort Research Committee, presented a report on "Riding Comfort and Cushions" at the Society's Summer Meeting. This report covers the seat cushion research work in progress at the University of Michigan, the test equipment for which was exhibited and demonstrated at the Meeting.

Three automotive sources, two motor car and one aviation, are actively coordinating, using, and further developing practical instruments having to do with vibration and riding comfort. The Committee is taking steps to draw into its membership representatives of the railroads and of the aircraft industry with a view to securing an interchange of ideas on instrumentation.

The April issue of "Instruments" contained an article, "Present Status of Instruments for Measuring Riding Comfort," prepared by R. W. Brown, chairman of the Riding Comfort Research Committee.

The Committee has resumed its study to determine the physiological and psychological reactions of a large group of individuals to variations in frequency and amplitude of vibration over a wide range.

Cooperative Fuel Research

The Society has continued to act as the secretariat for the Cooperative Fuel Research Committee, in the sponsorship of which it is joined by the Automobile Manufacturers Association, the American Petroleum Institute, and the National Bureau of Standards.

This work is supervised by five divisions:

I. Motor Fuels Division
II. Aviation Fuels Division
III. Automotive Diesel Fuels Division
IV. Non-Petroleum Fuels Division
V. Survey Division

The Cooperative Fuel Research Committee has undertaken to assemble material and to publish a compilation of test procedures, secondary reference fuel calibration curves, fuel specifications, and miscellaneous inspection data in current use by members of the Committee and its divisions. The purpose of this publication is to get together under one cover all of this material which is now being used by fuel technologists in both the automotive and petroleum industries but which has not been published by the ASTM or other standardizing body.

Most of the Motor Fuels Division's activity during the past year has centered around Detonation Projects, particularly the road test program and the project to develop an apparatus for controlling humidity and to select suitable limits for humidity in laboratory knock testing.

At the January, 1940 meeting of the Division, the Road Test Group was authorized to carry out, during the summer, exchange road tests on the knock-rating of motor fuels, in which each participating laboratory rated certain fuels by its own method or methods. One of the objects of these tests was to determine the desirability of conducting centralized tests in order to improve upon current road test procedures. These exchange road tests indicated that the methods used by various cooperating laboratories did not furnish adequate information pertaining to the knocking characteristics of motor fuels in passenger car engines. Accordingly, a program of centralized road tests was conducted under the auspices of the Motor Fuels Division at San Bernardino, Calif., from Oct. 8 to Nov. 15. During this period over 50 representatives of 33 participating organizations (which included the Army Ordnance Department) operated 24 test cars a total of approximately 100,000 miles. A 450-page report has been prepared covering the data obtained in these tests, and a summary report was presented at the Society's 1941 Annual Meeting.[1]

The Volatility Project is continuing its study of the correlation between current motor fuel volatility and automatic choke calibration and operation in the field. The program is supported by representatives from carburetor manufacturers, automobile manufacturers, and gasoline producers and special attention is being given to the methods of checking and calibrating automatic chokes from the standpoint of design, testing, and servicing.

Projects on instrumentation, test-engine modification, reference fuel calibration, road-test reference fuel development, high-octane test procedure, altitude testing, and monthly and semi-annual exchange are being continued on the active status.

The Aviation Fuels Division has sponsored five active projects: Full-Scale Detonation, Laboratory Detonation, Vapor Lock, Corrosion, and Volatility.

The results of full-scale tests, made by the Wright Aeronautical Corp. in June 1939, on two leaded aromatic blends indicated the importance of rating such fuels under take-off conditions as well as under cruising conditions. Take-off rating was discussed with representatives of the cooperating engine manufacturers and simplified procedures for obtaining such ratings have been outlined. The results of some full-scale tests by these methods have been reported and other tests are in progress. Available types of high-octane fuels have been discussed with representatives of various oil companies, and arrangements have been made for the procurement of four leaded test fuels. These test fuels will serve to determine the agreement of full-scale and laboratory ratings up to Reference Fuel S-1 plus 1.5 ml $PbEt_4$ per gal.

Late in 1939 a tentative laboratory method for knock-rating of aviation fuels was formulated by the Groups working on Laboratory Detonation Projects and reproducibility tests were conducted in a group of cooperating laboratories. On the basis of results of these tests it was recommended, at the meeting held in Detroit in January, 1940, that the method be adopted for use in the knock-rating of aviation fuels in the range up to and including 100 octane number, and that additional work be carried out in an attempt to further standardize the method. The Cooperative Fuel Research Committee at its Feb. 2 meeting adopted the proposed method to replace the C.F.R. Motor Method (ASTM D 357-39), which included the acid heat test, for the knock-rating of aviation fuels up to and including 100 octane number; and authorized the future program of the Laboratory Detonation Groups which provided for a meeting of a representative working group at the laboratories of the Waukesha Motor Co., Waukesha, Wis., to put the engine, equipment, and method into proper form for making ratings above 100 octane number while retaining the proper correlation with full-scale engine ratings below 100 octane number. Representatives of 14 cooperating laboratories made up the working group in session at Waukesha from Feb. 19 to March 8. A revision of the method was prepared and further cooperative tests conducted at Wright Field, Dayton, Ohio, March 26 to April 2. At the conclusion of these tests a joint meeting of the Aviation Fuels Division and the Laboratory Detonation Groups approved the method with minor revisions and with provision for humidity control, limiting the water content of the air supplied to the engine to not more than 50 grains of water per pound of dry air. The Cooperative Fuel Research Committee at its May 9 meeting adopted the "CFR Method of Test for Knock Characteristics of Aviation Fuels, 1940" with the understanding that the Laboratory Detonation Groups would proceed immediately to develop suitable apparatus for controlling humidity within the limits of the method. The National Bureau of Standards and the Waukesha Motor Co. were assigned this project; final tests on the humidity control apparatus were carried out at Wright Field in October 1940, and equipment for humidity control suitable for use with the Aviation Method has been approved.

During the past year the Aviation Fuels Exchange Group has been formally organized with a membership of 22 laboratories.

Progress on the investigation of the various phases of the problem of vapor lock in airplane fuel systems has been covered in 33 progress reports during the past year – 29 have been concerned with pressure drops in component parts of airplane fuel systems, 4 have been concerned with aviation fuel characteristics related to vapor lock. While the foregoing are all restricted reports for circulation to committee members only, a summary report was recently released for presentation to the Society by Dr. O. C. Bridgeman, Director of Vapor Lock Projects.[2]

The work on Corrosion Projects has been confined principally to the cooperative corrosion tests being conducted jointly by the Fuels and Materials Groups. The small test boxes which have been exposed with sump-water-fuel mixtures have now been in test somewhat over six months. Several preliminary inspections indicated that significant results are not likely to be obtained in less than about one year. Tests have been started on various corrosion inhibitors which are added either directly to the fuels or to the sump water. The Maintenance Group is continuing to collect service performance data on aluminum aircraft gasoline tanks and the effectiveness of the various procedures recommended for minimizing corrosion. The corrosion of certain interior locations of the wings by exhaust gases has been satisfactorily overcome by closing openings through which the exhaust gases enter and by the adequate paint protection now employed by the manufacturers. It is hoped that the fundamental principles of design laid down by the Design Group will result in improved design of gasoline tanks which will greatly minimize the possibility of corrosion occurring.

Considerable data on full-scale laboratory and flight tests were contributed to the Volatility Projects during the past year but an Analyzing Group concluded that tests at low carburetor air temperature are essential to determination of distribution effects of the fuels, and consequently it would be

[1] "The 1940 Cooperative Road Knock Tests – A Report from the Cooperative Fuel Research Committee," presented at the Annual Meeting of the Society, Jan. 6-10, 1941.

[2] "Report of CFR Committee on Aviation Vapor Lock Investigation," presented at the National Aircraft Production Meeting of the Society, Oct. 31-Nov. 2, 1940.

necessary to run tests during the winter 1940-41 before reaching any definite conclusions about the data. A new fuel, proposed for test purposes and known as the "Engine Manufacturers' Special 100 Octane Aviation Gasoline," has been added to the list of fuels to be tested in this program and a program of extensive flight tests during the current winter months has been approved.

The Automotive Diesel Fuels Division released for presentation by C. G. A. Rosen, division chairman, at the Society's Summer Meeting, an interim report covering the full-scale engine volatility tests being conducted on a cooperative basis by engine manufacturers, representatives of the four essential types of engine, and representatives of the petroleum industry.[3] Considerable test work has been completed since that time and the data are now being studied by an Analysis Group. The projects on instrumentation and test procedure are also active.

The Proposed Method of Test for Ignition Quality of Diesel Fuels was revised and recommended to the ASTM as a tentative standard. The ASTM, however, has again published the method as information only in the current report of Committee D-2.

The Automotive Diesel Fuels Division, following the general plan adopted some years ago by the Motor Fuels Division, has decided to give owners of CFR Diesel Fuel Testing Units an opportunity to participate twice yearly in the regular program of the Automotive Diesel Fuels Exchange Group. These semi-annual, non-member tests will be conducted in March and September of each year, starting with March, 1941.

The Non-Petroleum Fuels Division has been inactive during 1940.

The Survey Division has continued its three projects: Aviation Fuels Projects; Motor Fuels Projects; and Motor Projects.

The Aviation Fuels Group cooperating with representatives of the Council for National Defense, revised the recommended aviation gasoline specifications incorporating the "CFR Method of Test for Knock Characteristics of Aviation Fuels, 1940," and reducing the octane number grade classifications to three: 73, 91, and 100 octane number.

In accordance with the cooperative agreement entered into some years ago with the National Bureau of Mines whereby the Bureau completes the analysis of data collected by the Committee in a National motor gasoline survey, and issues a semi-annual report covering the winter and summer gasolines sold throughout the Country, the tenth survey handled under this joint agreement has just been released for publication.

The Groups working on Motor Survey Projects have cooperated with the Motor Fuels Division and the Automotive Survey Committee of the American Petroleum Institute in carrying out 1940 cooperative road tests. Part I of this year's program, determination of octane requirement and vapor pressure limits on 1938, 1939, and 1940 cars of all makes as found in service, followed the general plan of the tests conducted in the 1938 and 1939 surveys for securing octane number and limiting vapor pressure requirements for automobiles. Part II constitutes a research on the factors affecting octane requirements of 1940 cars such as combustion chamber deposits and ignition timing.

G. W. LEWIS, *Chairman*

[3] See SAE Transactions, this issue, pp. 72-75, "Rating Automotive Diesel Fuels in Full-Scale Engines," by C.G.A. Rosen.

Treasurer's Report

BALANCE SHEET AS OF SEPT. 30, 1940

ASSETS

Cash	$35,781.77
Accounts Receivable	1,091.90
Securities	223,006.01*
Accrued Interest on Securities	2,638.13
Inventories	688.50
Furniture	1,000.00
Items Paid in Advance, Charges Deferred	1,872.25
TOTAL ASSETS	$266,078.56

LIABILITIES AND RESERVES

Accounts Payable	$8,860.62
National Dues and Miscellaneous Items Received in Advance	7,976.60
Reserve Set Aside for Anticipated Expenses	11,355.70
General Reserve	221,695.37
Net Unexpended Income	16,190.27
TOTAL LIABILITIES AND RESERVES	$266,078.56

* Book Value (Market Value, Oct. 2, 1940 – $216,980.00)

INCOME AND EXPENSE AND BUDGET COMPARISON
12 MONTHS, ENDING SEPT. 30, 1940

INCOME

	Oct. 1, 1939 to Sept. 30, 1940	Budget 1939-1940	Oct. 1, 1938 to Sept. 30, 1939
Dues and Subscriptions	$89,848.85	$84,000.00	$84,968.05
Initiation Fees	13,692.50	13,000.00	12,476.00
Interest and Discount	7,884.93	8,000.00	7,987.77
Affiliated Appropriations	21,985.00	20,000.00	17,343.75
Advertising – Journal	89,351.50	85,000.00	78,019.00
Advertising – Handbook	7,525.00	6,000.00	5,625.00
Miscellaneous Sales	27,123.11	25,000.00	26,425.75
Unused Portion of Section Dues	2,285.50	....	2,789.32
Profit on Sales of Securities	1,775.93	....	231.25†
TOTAL INCOME	$261,472.32	$241,000.00	$233,403.39

EXPENSES

	Oct. 1, 1939 to Sept. 30, 1940	Budget 1939-1940	Oct. 1, 1938 to Sept. 30, 1939
Research	$15,849.65	$14,800.00	$15,222.11
Standards	8,578.15	8,080.00	7,941.97
Publications	52,679.56	50,320.00	50,884.42
Sections	6,892.96	8,580.00	7,570.22
Meetings	14,535.60	16,609.00	19,452.82
Institutional Promotion	2,044.78	1,760.00	1,890.57
Professional Activities	181.33	200.00	153.56
Membership Increase	11,186.84	10,560.00	10,970.99
Advertising – Journal	30,896.81	30,280.00	29,344.18
Advertising – Handbook	1,279.67	1,120.00	1,095.69
Miscellaneous Sales	10,136.07	10,000.00	9,644.15
General Expense	75,804.34	76,171.00	78,337.65
National Defense	3,486.97	....	....
Engineering Relations	11,729.32	12,500.00	11,547.63
TOTAL EXPENSES	$245,282.05	$240,980.00	$244,055.96
Net Unexpended Income	$16,190.27	$20.00	$10,652.57†

† Deficit

THE Finance Committee's recommendation of a balanced budget for the fiscal year ending Sept. 30, 1940, was definitely exceeded, the net unexpended income for the period being $16,190.27.

For the previous fiscal year operations resulted in a deficit of $10,652.57.

The improvement during 1940 as compared with 1939 was owing to an increase from dues and subscriptions, an increase in Journal advertising and increased appropriations from industrial groups for Research and Standardization work.

Income and expenses for the year as compared with the budgeted figures and also the actual figures for the previous year were as follows:

	Income	Expense
Actual (1939-40)	$261,472.32	$245,282.05
Budgeted (1939-40)	241,000.00	240,980.00
Actual (1938-39)	233,403.39	244,055.96

The comparative Balance Sheet and Income and Expense statements, which are a part of this report, give the details of operation for the past year as compared with budget estimates and the operating figures for 1938-39.

During the past fiscal year the investment portfolio of the Society was increased by $2,594.99. At the close of the fiscal year the total book value of securities held was $223,006.01 and their actual market value on the same date was $216,980.00.

As is customary each year, the books of account have been audited by Haskins and Sells.

DAVID BEECROFT, *Treasurer*

APPLICATIONS Received

The applications for membership received between Dec. 15, 1940, and Jan. 15, 1941, are listed below. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

Baltimore Section

Freeman, Aaron, superintendent, buildings, supplies and motor equipment, The Chesapeake & Potomac Telephone Co. of Baltimore City, Baltimore, Md.

Gray, Edward, Captain, Ordnance Department, U. S. Army, Washington, D. C. Mail: Aberdeen Proving Ground, Maryland.

Canadian Section

Cooke, Philip N., sales manager, Norton Co. of Canada, Ltd., Hamilton, Ont.

McCoy, D. Bertram, assistant sales manager, The Steel Co. of Canada, Ltd., Hamilton, Ont.

Chicago Section

Bryant, Elmer J., district manager, Greenfield Tap & Die Corp., Greenfield, Mass. Mail: 611 Washington Blvd., Chicago.

Page, F. A., superintendent of maintenance, United Air Lines Transport Corp., Chicago.

Raffay, Andrew, Jr., equipment sales engineer, Purolator Products, Inc., Newark, N. J. Mail: Lake Shore Club of Chicago, 850 Lake Shore Drive, Chicago.

Rosenberg, Charles Bertram, diesel engineer, Pure Oil Co., Research Laboratory, Chicago.

Cleveland Section

Bubb, H. D., Jr., chief engineer, Thompson Products, Inc., Cleveland.

Krider, John P., machinist, Thompson Products, Inc., Cleveland.

Lusty, Cameron Nathaniel, stress analyst, Taylorcraft Aviation Corp., Alliance, Ohio.

Lyon, Walter E., development engineer, Firestone Tire & Rubber Co., Akron, Ohio.

Pittenger, Tress E., factory manager, Firestone Tire & Rubber Co., Akron, Ohio.

Tran, M. A., chief metallurgist, The Park Drop Forge Co., Cleveland.

Dayton Section

Bain, Walter G., Captain, Air Corps, Materiel Division, U. S. Army, Wright Field, Dayton, Ohio.

Curtis, Russell R., executive vice president, Curtis Pump Co., Dayton, Ohio.

Daum, George A., assistant superintendent, Frigidaire Division, General Motors Corp., Dayton, Ohio.

Gaylord, Foster R., superintendent of maintenance, Columbia Terminals Co., Inc., Norwood, Ohio.

Detroit Section

Anderson, Marvin R., vice president, Michigan Tool Co., Detroit.

Biggers, Robert L., president, Fargo Division, Chrysler Corp., Detroit.

Blocher, O. G., chief draftsman, Stinson Aircraft Division, Vultee Aircraft, Inc., Wayne, Mich.

Bolton, Smith, assistant sales manager, United States Graphite Co., Saginaw, Mich.

Bradley, M. A., sales engineer and representative, Budd Wheel Co., Detroit.

Diederich, John W., federal transport engineer, Chevrolet Motor Division, General Motors Corp., Detroit.

Doolittle, J. H., Major, Air Corps, U. S. Army. Mail: 8505 W. Warren Ave., Detroit.

Drader, Joseph C., works manager, Michigan Tool Co., Detroit.

Fontaine, A. P., chief engineer, Stinson Aircraft Division, Vultee Aircraft, Inc., Wayne, Mich.

Franklin, Floyd A., electrical engineer, General Motors Truck & Coach Division, Yellow Truck & Coach Mfg. Co., Pontiac, Mich.

Glezen, William Marshall, experimental engineer, Monroe Auto Equipment Co., Monroe, Mich.

Henderson, Romey A., industrial teacher, Detroit Board of Education, Department of Vocational Training for National Defense, Detroit.

Kasey, Myron, draftsman, Briggs Mfg. Co., Detroit.

Lawson, Seward N., partner, Moore Laboratories, Detroit.

Mainzinger, Harry O., sales engineer, Budd Induction Heating, Inc., Detroit.

Orr, A. William, Jr., automotive engineer, Holley Carburetor Co., Detroit.

Rehm, Harold W., Lt.-Col., Ordnance Department, U. S. Army, Detroit Ordnance Plant, Detroit.

Roberts, Fred T., service and sales representative, Budd Wheel Co., Detroit.

Smith, Bruce A., standards engineer, General Motors Corp., Detroit.

Ruhl, Fremont F., sales engineer, United States Graphite Co., Saginaw, Mich.

Rupert, Brestle A., production manager, Stinson Aircraft Division, Vultee Aircraft, Inc., Wayne, Mich.

Smith, Tom Y., industrial engineer, Stinson Aircraft Division, Vultee Aircraft, Inc., Wayne, Mich.

Spencer, Lawrence C., inspector, A C Spark Plug Co., Flint, Mich.

Van Auken, Raymond, manager, bus, truck and trailer department, Budd Wheel Co., Detroit.

Wilson, Earl R., assistant resident engineer, Chevrolet Motor Division, General Motors Corp., Flint, Mich.

Indiana Section

Cosper, Dale L., body draftsman (Motor Truck Division), International Harvester Co., Fort Wayne, Ind.

Milne, Kenneth T., carburetor engineer, Delco Radio Division, General Motors Corp., Kokomo, Ind.

Metropolitan Section

Barber, Robert T., engineer, International-Plainfield Motor Co., Plainfield, N. J.

Beyer, Howard Charles, checker, engineer, Ranger Aircraft Engines, Farmingdale, L. I., N. Y.

Chandler, William Heywood, junior test engineer, Wright Aeronautical Corp., Paterson, N. J.

Christenson, H. Eric E., tester, International-Plainfield Motor Co., Plainfield, N. J.

Droge, Henry N., service engineer, Kollsman Instrument Div., Square D Company, Elmhurst, L. I., N. Y.

Dzielinski, John, detail draftsman, Ranger Aircraft Engines, Farmingdale, L. I., N. Y.

Feld, Robert Tillman, junior automotive engineer, Research & Development Division, Socony-Vacuum Oil Co., Inc., Paulsboro, N. J.

Gundlach, Frank A., technical supervisor, National Carbon Co., Inc., New York.

Leimbach, Marcel, salesman, United States Steel Export Co., New York.

McCord, Earl K., junior test engineer, Wright Aeronautical Corp., Paterson, N. J.

Reese, Ivan Harold, service representative, Wright Aeronautical Corp., Paterson, N. J.

Rudert, Anton, draftsman, Ranger Aircraft Engines, Farmingdale, L. I., N. Y.

Sanborn, John A., general manager, Manufacturers Aircraft Association, Inc., New York.

Scheifele, Ernst, partner, Aero Trades Co., Roosevelt Field, Mineola, L. I., N. Y.

Siltanen, John Carl, engineer, Brewster Aeronautical Corp., Long Island City, N. Y.

Stanitzke, Otto J., assistant general manager, Linden Division, General Motors Corp., Linden, N. J.

Milwaukee Section

DeLong, Roger G., sales engineer, Twin Disc Clutch Co., Racine, Wis.

Robinson, Kenneth Irving, draftsman, Sterling Motor Truck Co., Inc., Milwaukee.

Wright, Leo George, foreman, City of Milwaukee, Municipal Garage, Milwaukee.

New England Section

Thomas, Hollis O., Jr., service manager, Needham Garage, Inc., Chapel Street Garage, Needham, Mass.

Northern California Section

Dacus, Hugh, president, Dacus Oil Co., San Francisco, Calif.

Nash, Ivan H., foreman, Caterpillar Tractor Co., San Leandro, Calif.

Northwest Section

Kuhe, Harry, division manager, Ethyl Gasoline Corp., Seattle, Wash.

Ray, James H., owner, Carburetor Service Co., Spokane, Wash.

Severin, Roy Theodore, manager, Gasoline Tank Service Corp., Seattle, Wash.

Philadelphia Section

Adler, Milton D., project engineer, Jacobs Aircraft Engine Co., Pottstown, Pa.

Noble, Herbert J., chief metallurgist, Jacobs Aircraft Engine Co., Pottstown, Pa.

Tynan, Thomas G., manager of auto manufacturing sales, Electric Storage Battery Co., Philadelphia.

Pittsburgh Section

Stewart, James P., assistant manager, Blower Department, Elliott Co., Jeanette, Pa.

St. Louis Section

Bank, Herman, stress analysis, St. Louis Airplane Division, Curtis-Wright Corp., Robertson, Mo.

Kohr, Bradley G., instructor, Parks Air College, Inc., East St. Louis, Ill.

Wisner, Edward J., auto mechanic, City of St. Louis, Water Division, St. Louis, Mo.

Southern California Section

Bunsen, William F., junior executive, Engineering Department, Ryan Aeronautical Co., San Diego, Calif.
Clark, John B., fleet manager, Peacock Dairies, Inc., Bakersfield, Calif.
Curtis, W. H., president, Curtis Pump Co., Dayton, Ohio. Mail: 5640 Franklin Ave., Hollywood, Calif.
Hansen, Sam S., chief industrial engineer, General Petroleum Corp. of California, Los Angeles.
Fluent, James R., quality manager, Menasco Mfg. Co., Burbank, Calif.
Horst, Paul S., master mechanic, South Gate Fire Department, South Gate, Calif.
Johnson, Albert K., group engineer, Lockheed Aircraft Corp., Burbank, Calif.
Peterson, Joseph James, junior specification engineer, Lockheed Aircraft Corp., Burbank, Calif.
Price, Nathan C., consulting engineer, Lockheed Aircraft Corp., Burbank, Calif.
Schwendener, Karl D., project engineer, Librascope, Inc., Burbank, Calif.
Seidel, Gus A., chief inspector, Hughes Aircraft Co., Hollywood, Calif.
Westermeier, Warren Frederick, test engineer, Menasco Mfg. Co., Burbank, Calif.

Southern New England Section

Bachman, Oscar L., application engineer, American Bosch Corp., Springfield, Mass.
Gordon, W. A., engineer, Farrel-Birmingham Co., Inc., Ansonia, Conn.
McAllister, Donald, mechanical engineer, Worthington Pump & Machinery Corp., Holyoke, Mass.
Rice, Wilbur Currier, production engineering department, Pratt & Whitney Aircraft Division, United Aircraft Corp., East Hartford, Conn.
Shepard, Amos Edward, designer, Pratt & Whitney Aircraft Division, United Aircraft Corp., East Hartford, Conn.
Thomas, Kenneth Funston, district sales engineer, SKF Industries, Inc., Hartford, Conn.

Syracuse Section

Flannery, John P., assistant chief engineer, Aircooled Motors Corp., Syracuse, N. Y.
Fogarty, George E., engineer, Seneca Falls Machine Co., Seneca Falls, N. Y.
Roth, Carl F. B., general sales manager, Aircooled Motors Corp., Syracuse, N. Y.

Outside of Section Territory

Bailey, Malcolm, Sr., lubrication engineer, sales manager, Dixie Oil Co., Tampa, Fla.
Bridges, Fitz James, field representative, Ethyl Gasoline Corp., Seattle, Wash. Mail: P. O. Box 1367, Great Falls, Montana.
Briscoe, Maurice A., salesman, Wyoming Automotive Co., Casper, Wyoming.
Darling, Charles M., Jr., sole owner, Allegany Oil Co., Houghton, Mich.
Fuller, Paul W., chief engineer, FitzJohn Coach Co., Muskegon, Mich.
Ginn, Earl, chief engineer, Commercial Engine Division, Continental Motors Corp., Muskegon, Mich.
Goode, H. M., Sergeant, Royal Canadian Air Force, Saskatoon, Saskatchewan, Canada.
Kearns, Earl E., head, Urban Transportation Section, General Electric Co., Erie, Pa.
Sherman, Coolidge, sales department, Allegheny Ludlum Steel Corp., Watervliet, N. Y.
Wroblewski, Woodrow L., engineer, Wroble Engineering Co., Schenectady, N. Y.

NEW MEMBERS Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Dec. 15, 1940, and Jan. 15, 1941.
The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

Canadian Section

Corp, Frederick Harold (A) chief technician, service manager, Canadian Garages Co., 636 Bay St., Toronto, Ont. (mail) 7A Elm St.

Chicago Section

Greenlee, Harry R. (M) engineer, charge of transmission design, Studebaker Corp., South Bend, Ind. (mail) 1232 Longfellow St.
Hagenbook, L. D. (M) assistant chief engineer, Goodman Mfg. Co., 48th & Halsted Sts., Chicago.
Hammel, George E. (A) special representative, national accounts division, Studebaker Sales Corp. of America, 2555 S. Michigan Ave., Chicago.
Watrous, Christopher Beach (A) lubrication engineer, Valvoline Oil Co., Tribune Tower Bldg., Chicago.

Cleveland Section

Arnold, Richard (J) director of engineering, Lubri-Zol Corp., Wickliffe, Ohio (mail) 2830 E. 130th St., Shaker Heights, Ohio.
Weatherhead, Albert J., Jr. (A) president, Weatherhead Co., 300 E. 131st St., Cleveland.

Detroit Section

Assessor, Albert J., Jr. (A) assistant development engineer, Federal-Mogul Corp., 11031 Shoemaker Ave., Detroit.
Deisley, Edward J. (M) chief body engineer, Edw. G. Budd Mfg. Co., 12141 Charlevoix Ave., Detroit.
Dekker, G. J. (A) manager, Air Reduction Sales Co., 7991 Hartwich St., Detroit.
Marchant, Joseph Richardson (J) checker, Chrysler Corp., Highland Park, Mich. (mail) 111 Highland Ave.
Sinclair, Charles W. (M) chief engineer, Kelsey-Hayes Wheel Co., 3600 Military, Detroit.
Petterson, Anders G. (M) designer, Bower Roller Bearing Co., 3040 Hart Ave., Detroit (mail) 7708 E. Jefferson.

Indiana Section

Badgley, Ollie V. (A) general manager, Delco-Remy Division, General Motors Corp., Anderson, Ind.

Metropolitan Section

Bednall, Robert E. (A) president, Allen Bros. Garage, Inc., 741 Main St., Stamford, Conn.
Flynn, Roland W. (A) division lubrication engineer, Gulf Oil Corp., 17 Battery Place, New York.
Gondeck, Frank J. (A) shop foreman, Layng & Co., Inc., 150 Morris Ave., P.O. Box 606, Springfield, N. J. (mail) 35 Kingsley Ave., West Brighton, S.I., N.Y.
Greenspan, Arnold (A) vice president, New York Motor Supply Co., 112 Richmond Ave., Staten Island, N. Y. (mail) 248 Hart Blvd., West Brighton, S.I., N.Y.
Hanauer, Elbert A. (M) automotive engineer, Mack Mfg. Corp., 34th St. & 48th Ave., L.I.City, N.Y. (mail) 92-16 195th Place, Hollis, L.I., N.Y.
Hofman, Erik (F M) technical supervisor, International Aviation Associates, Artillery House, Artillery Row, London, S.W. 1, England (mail) Room 367, 26 Broadway, New York.
Koerner, Herman J. (A) officer, John Koerner's Sons, Inc., 291 Wallabout St., Brooklyn, N. Y.
Kurlander, John H. (M) illuminating engineer, Westinghouse Lamp Division, Westinghouse Electric & Mfg. Co., Bloomfield, N. J.
Oblinger, Richard L. (J) engine tester, Wright Aeronautical Corp., Paterson, N. J. (mail) 325 Plaza Rd., N., Radburn, N. J.
Richardson, Sewall F. (J) test observer, Wright Aeronautical Corp., Paterson, N. J. (mail) 260 17th Ave.
Weiss, Orin Andrew (M) consulting engineer, P. O. Box 19, Station C, New York.

Milwaukee Section

Janes, John J. (J) engineer, Standard Foundry Co., Racine, Wis. (mail) 3019 Northwestern Ave.
Schulze, Frederick C. (A) assistant sales manager, Waukesha Motor Co., Waukesha, Wis. (mail) 118 W. Laflin Ave.

Northern California Section

Junge, Walter A. (A) owner, W. A. Junge Truck Co., Stockton, Calif.; W. A. Junge Truck Co., Sumner, Wash. (mail) 304 W. Weber Ave., Stockton, Calif.

Oregon Section

Wetterborg, A. E. (A) manager, Federal Mogul Corp., 205 N. W. 10th Ave., Portland, Ore.

Southern California Section

Hutton, Harold (A) lube marketing department, Richfield Oil Corp., 555 S. Flower St., Los Angeles. (mail) 1020 S. Westmoreland Ave., Apt. A.
Johnson, Warren Henry (A) tire maintenance foreman, Department of Water & Power, City of Los Angeles, Los Angeles. (mail) 5427 Templeton St.

Southern New England Section

Buck, Richard S. (M) research engineer, Pratt & Whitney Aircraft Division, United Aircraft Corp., East Hartford, Conn.
Clark, John Alston (M) weight analyst, Pratt & Whitney Aircraft Division, United Aircraft Corp., East Hartford, Conn. (mail) 211 N. Whitney St., Hartford, Conn.
Ur, Elmer Raymond (J) draftsman, Pratt & Whitney Aircraft Division, United Aircraft Corp., East Hartford, Conn. (mail) 24 Dewey St., New Britain, Conn.

(Concluded on page 70)

Synthetic Rubber Result Of Long-Range Program

▪ *Tulsa Group*

Transforming the Dec. 13 meeting of the Tulsa Group into an experimental laboratory, Dr. J. N. Street, director of chemical research, Firestone Tire & Rubber Co., gave an actual demonstration of the process by which synthetic rubber is made from butadiene. Dr. Street used the demonstration to augment his paper, "Synthetic Rubber," in which he emphasized that the present state of development in this field "has not been reached through any frantic research efforts prompted by a temporary hysteria over national defense." It is the result of a long range program, he said, forecasting that in the distant future "we may even face the situation so common with many of nature's products wherein the synthetic may become even more acceptable from the quality angle and at the same time reach a cost which may make it more economical."

None of our materials is true synthetic rubber, he stated. To fulfill such a definition, he added, the material must have not only the same chemical make-up or structure as rubber, but also the same general physical properties – the name "rubber-like" more aptly describes present materials.

Dr. Street pointed out that certain of the synthetics cannot be vulcanized to accomplish a similar change in characteristics as occur to rubber when vulcanized; that is, to retain a high degree of elasticity under a wide range of temperature changes. These materials, he said, are formed or molded to the desired shape at higher temperature (250-300F), just as in the case of rubber, but if the fabricated product is again subjected to temperature in service approximating these conditions, the part flows and becomes permanently distorted. Even at somewhat lower temperatures flow under load or permanent set takes place. Thus, he noted, for this reason alone, these certain synthetics are not serviceable for tires – which take some 65% of our crude rubber.

On the other hand, he declared, for certain special uses, each of these products has definite value. They have characteristic resistance to various materials such as oils, acid and caustic, which make them of particular value to the engineer for gaskets, tubing, insulation and other uses where their properties cause them to do a much better job than rubber. In general, he said, they find a use where flexibility is required but a high degree of elasticity is not essential – they might better be classed as "flexible plastics" than synthetic rubber. Among materials Dr. Street included in this group are AXF, Koroseal, and Vistanex. Thiokol, he noted, undergoes a change somewhat parallel to vulcanization, but has too high a plastic flow and too low a tensile strength to be considered except for specialty usage.

BUNA

"The name 'Buna' sounds peculiar but its derivation is quite simple. The first two letters – bu – come from the chemical called butadiene (C_4H_6) and the last two – na – from the chemical term natrium, which in many languages is the name of the very active metal that we in the English-speaking world call sodium. The reason for this combination is that butadiene when brought in contact with metallic sodium will polymerize forming a rubber-like mass."—Dr. J. N. Street.

There are two types of products available today that might serve to replace natural rubber – Neoprene and Butadiene polymers – he said.

Dr. Street explained that rubber is polymerized isoprene. "Isoprene molecules might be considered as hooked to each other end-to-end to form a giant molecule, just as freight cars are hooked up to form a train. If we take, instead of isoprene, the related material called 2-chlorobutadiene, the resulting product is Neoprene. Similarly, if we start with butadiene itself, the product is the Buna-type synthetic."

He pointed out that products from butadiene alone are inferior, but that two butadiene types or copolymers (the copolymer with styrene – Buna S, and that with acrylonitrile – Buna N) are of decided commercial interest. Buna N is of value because of its high oil resistance, but has no immediate value for tires or as a general replacement for rubber owing to the difficulty of fabricating products from it. On the other hand, Dr. Street commented, Buna S is readily processible, but in general is of value only as a replacement material for rubber, being subject to most of the shortcomings of rubber and having no outstanding properties of its own.

The more recent materials announced, including Ameripol (Goodrich), Chemigum (Goodyear), and Synthal (U. S. Rubber), he said, are modified Buna products, as are products of Standard Oil and Firestone. Neoprene (du Pont) has been in use a number of years, he added, and is a very useful product both for specialties and as a replacement of rubber.

Commenting on the physical properties of the synthetics as compared with rubber, Dr. Street addressed the following remarks to automotive engineers: "There have been indications of a move toward higher underhood temperatures in automobiles. Possibly the better heat resistance of synthetics may be of interest from this standpoint. If better oil resistance is needed, the engineer may find the Buna N type polymer will give him an improved product, particularly where low compression set is also an important factor. If compression set is of secondary importance, then one of the newer Neoprenes may be satisfactory. If, in addition, temperatures are high and the efficiency of the stock is also an important factor, then Neoprene will be found more satisfactory. If compression set is not a factor, then Thiokol, particularly if supported, may be the most desirable."

Turning to tires, Dr. Street revealed that on test cars Buna S has given wear equivalent to that of the best rubber treads; that under best conditions of both compounding and service Buna N has proved somewhat better than Buna S; and that Neoprene tires give results equal to those produced from rubber. He pointed out that use of Buna N in tires without modification or the addition of rubber or an excessive amount of softener is hopeless, owing to processing and fabrication problems.

Dr. Street feels that while all the problems on replacement of rubber by one of the Buna-type or Neoprene polymers have not been worked out in the field of automobile mechanicals, sufficient information is at hand to justify the opinion that they could be worked out quickly if necessary. The eventual course of using any or all of these synthetics in tires, he said, depends upon whether a free market is to exist on crude rubber, and economic conditions involved. There has not been sufficiently large production of any of these products, he said, to actually predict their eventual cost. Furthermore, he added, the ever changing situation of world economics as well as production regulation is such that the price of crude rubber itself, which must be considered, is as difficult to predict as that of synthetics.

English War Needs Speed Canadian Rubber Output

▪ *Canadian*

In addition to supplying England with large quantities of tires for army vehicles, Canadian rubber manufacturers, in 1940, completed overseas shipments of something like 500 miles of fire and garden hose. H. S. Pritchard, sales manager, general mechanical rubber products and Dunlopillo cushioning division of Dunlop Tire & Rubber Goods Co. of Canada, Ltd., in his paper, "New Developments In and Uses of Rubber," delivered Dec. 18, left little doubt in the minds of Canadian Section members as to the tremendous strides the Canadian rubber industry is taking today not only in blanketing domestic needs but in assisting the Motherland in the present conflict.

Recounting some of the interesting recent accomplishments of the Canadian rubber designers, Mr. Pritchard said that three years ago they were approached by the British War Office to develop a tire which "though punctured by bullet or by other means,

could carry on for at least 50 miles at speeds up to 40 miles an hour, without damaging the tire." A large order – but the ingenuity of the Canadian designers was more than a match for the problem. "Today," Mr. Pritchard said, "large numbers of Canadian as well as British mechanized vehicles are equipped with special 'runflat' tires."

For years rubber has been considered one of the best insulators of electricity. However, Mr. Pritchard recounted, mysterious explosions in various industrial plants were traced to static electricity stored in rubber. "In the average rubber factory," the speaker stated, "during winter months when the inside air is comparatively dry, static sparks are not only uncomfortable but especially so if a solvent is being used, having frequently started fires."

Little wonder, the speaker continued, that the rubber chemist attacked this common menace. Out of extensive research on the subject, Mr. Pritchard said, a new use for rubber was born – the chemist found that by using suitable materials suitably handled he can make a rubber compound which has a degree of electrical conductivity to take care of static electricity accumulated in various operations. "The interesting feature about this new development," Mr. Pritchard pointed out, "is that rubber with good mechanical properties can be made with any specific electrical resistance between the limits of 1 ohm to 10^{10} ohms."

The speaker's talk was made up of a synoptic review of the evolution of the rubber industry, starting back in 1615 when Spanish troops in Mexico were waterproofing garments with rubber latex and working up to the present war-time emergency; a description of various types of foam rubber; statistics on the synthetic rubber outlook; and a comprehensive picture of Canadian rubber activities today.

In 1939, there were 53 plants in the Dominion manufacturing rubber goods of one kind or another, Mr. Pritchard stated. These plants employed 14,000 persons. Capital invested amounted to over $80,000,000 and the value of goods produced that year approximated $65,000,000.

"While later comparisons are not yet available," Mr. Pritchard said, "In 1937, a year when business was reasonably active, Canada ranked the 6th largest importer of raw rubber in the world. Countries ranking higher than Canada, in order of their importance, were the United States, the United Kingdom, Japan, Germany and France."

Tires and tubes account for 47% of total Canadian rubber sales, the speaker continued, rubber footwear approximate 30%, and miscellaneous rubber goods 23%. Exports run to $15,000,000 and consist largely of tires and footwear.

When the belligerents across the water began banging away at each other and Japan definitely threw in her lot with the Axis, the possibility of a disruption in the Canadian rubber supply took on a rather serious aspect, the speaker said. Whereupon, the rubber association approached the Canadian Government with a scheme for building up adequate stocks of crude rubber in Canada to tide over any emergency. An agreement was happily reached, Mr. Pritchard reported. Approximately one year's requirement of rubber will be held in reserve in Canada by the end of June, 1941.

Diversified rubber products, ranging from huge aircraft tires to rubber treads lathe-cut to 1/120 of an inch, were exhibited at the meeting. Presiding was Section Chairman Norman Daniel.

Defense Orders Spur Plastics Industry

▪ Cleveland

The National Defense program will exert tremendous influence on the growth of the plastics industry in this country, was the opinion stated by W. B. Hoey, Bakelite Corp., in his address before the Cleveland Section on Dec. 2. While the plastics industry is still 'small fry' when rated in terms of big business, the speaker said, defense preparedness will greatly accelerate plastic production.

The most dramatic innovation will be the plastic airplane, he said. The preparedness drive, Mr. Hoey declared, will provide the incentive to speed it into commercial production with the least possible delay.

"Gas masks are already being made with plastics and there has been talk of plastic gun stocks," Mr. Hoey stated. "The Navy already uses thousands of molded parts on every ship – even electrical outlet boxes – and molded parts are most important functions of fire control mechanisms and communication systems for both the land and sea forces. These materials are being considered for parts of shells and bombs, and certainly they have something to offer in their ease of mass production."

The plastics industry today might be compared to the automobile industry in 1900, the speaker said. If interest and demand continue, he added, it would seem possible for plastics to experience the same sort of expansion as automobiles. However, he assured his audience, it will not be an overnight transition.

The big increase in the plastics business, the speaker said, has occurred over the last 10 years. The 6,000,000 lb of plastic material estimated produced in 1920 had jumped to about 140,000,000 lb in 1939 with the trend going upward. Today, automobiles alone probably take somewhere in the neighborhood of 12,000,000 lb, Mr. Hoey said, citing the 1941 Buick 'Series 51' as an average plastic consumer with 84 plastic parts per vehicle.

Commenting on current articles concerning the development of the plastic automobile body, the speaker said that he did not doubt but that the project would materialize. However, he definitely modified the term 'near future.' "In all probability," he said, "plastics will be used in airplanes and auto-

Chalk Talk

Roland B. Bourne, Maxim Silencer Co., uses the blackboard to illustrate a point in presenting his paper, "Technical Aspects of Exhaust Silencing," before members of the Southern New England Section, Jan. 8

Reports Studies on Exhaust-Silencer Design

▪ So. New England

In a discussion of the "Technical Aspects of Exhaust Silencing," presented to the Southern New England Section on Jan. 8, Roland B. Bourne, research engineer for the Maxim Silencer Co., pointed out that the design of a silencer depends on where the exhaust is located. Is the internal-combustion engine located in a normally quiet neighborhood or is there a high noise level present anyway due to subways, heavy truck traffic? An exhaust directed into a courtyard may be very unpleasant due to resonant conditions, he explained.

Mr. Bourne said that 80 to 100 explosions per sec will produce a recognizable pitch to the exhaust and that it is necessary to break up the heavy surge of gas in the silencer and prevent it from getting out into the air where it would cause noise upon contact with the ear.

Many curves and slides were presented showing the results of experimental work on different designs of silencers, and several cut-away models were available for inspection. One curve showed the effect on horsepower of length of exhaust pipe on a two-stroke cycle engine. Maximum power was obtained with a pipe length equal to one-sixteenth wave length, while at a quarter wave length the horsepower was a minimum, the power rising again with an increase in pipe length. By introducing a silencer, he stated, it was possible to eliminate the minimum altogether, and get about 30% increase in power.

When asked about the back pressure caused by a silencer, the speaker said that the back pressure varies with the position of the silencer along the exhaust pipe and in one spot was found to be 2 in. of water.

mobile bodies . . . but, in the case of automobile bodies, there is still the question as to what the plastic may be." With aircraft, the suitable material has been found, Mr. Hoey stated . . . plywood bonded with phenolic resins.

At least four aircraft companies are engaged in building experimental plastic planes and two major research institutions are active in this field. The big problem here, the speaker said, is to perfect a molding technic that will eliminate huge and expensive presses and costly dies and which will mold whole wing sections and half fuselages in one operation.

Definition of plastics, classification of plastic materials, description of these materials, and graphic illustrations on how to choose the right plastic for the job, were covered in Mr. Hoey's talk. " . . . The automotive industry has been guilty of some rather glaring misapplications of plastics over the past few years," Mr. Hoey said. "In most cases," he pointed out, "the reason has been that engineers, in their eagerness to utilize something different for styling, have adopted materials without realizing the limitations of those materials. . . . This latter condition is now very much improved after some bitter experiences, and most manufacturers have now set up specifications which molded parts must meet."

College Host to SAE Club of Colorado

Meeting at the Golden Hotel, Golden, Colo., 53 members and guests of the SAE Club of Colorado were joined for dinner by faculty members from the Colorado School of Mines, located in that city.

After dinner the group moved to the college campus where they were addressed by Dean Jesse R. Morgan, who spoke on the history and purpose of the college. Following the talk, members of the faculty and students conducted the group through the geophysics and metallurgical laboratories.

Automobile Companies to Make Aircraft Assemblies

Commenting on the national defense production partnership between some of the major automobile and aircraft manufacturing companies, announced early last month, **Dr. George Mead,** of the National Defense Advisory Commission, told newspapermen that it was the Commission's intention to have the three large automotive corporations, Ford, General Motors, and Chrysler, make assemblies for 1200 planes each – a total of 3600.

Dr. Mead said that Ford would manufacture parts for heavy-bombardment aircraft – 4-engine bombers to be assembled at a new Consolidated Aircraft Corp. plant in Texas, and a new Douglas plant in Oklahoma. Parts for the Glenn L. Martin B-26 medium bomber will be built by Chrysler, and General Motors will manufacture parts for North American Aviation's B-25 medium bomber. They will be assembled at Midwestern and Southwestern plants, he added.

Edsel Ford, on a recent trip to Southern California, remarked that chances of his company meeting demands for 1200 bombers look excellent, but that he would have to check with his engineering staff before making a definite commitment. At the SAE Annual Meeting in Detroit, **K. T. Keller,** Chrysler president, announced that his company, the Glenn L. Martin Co., and the Defense Commission have reached a tentative agreement on the production program.

In California, **Walter A. Hamilton,** Douglas company's chief of materiel, announced the signing of sub-contracts for production of airplane sub-assemblies with the Murray Corp. of America and Briggs Mfg. Co., both of Detroit; Fleetwings, Inc., of Bristol, Conn., and McDonnell Aircraft Corp., of Robertson, Mo. He explained that the Eastern plants are to manufacture wing sections, tail groups, engine nacelles, and other major units to be assembled into completed airplanes at the new Douglas factory under construction at Long Beach, Calif. The Fisher Body Division of General Motors is making jigs, fixtures and tooling for the new plant, it was stated.

Airplane engines produced at the Wright Aeronautical Corp. plant at Paterson, N. J., now represent more than 1,000,000 hp per month, according to a recent announcement by **Guy W. Vaughan,** president of the Curtiss-Wright Corp., the parent organization. The record horsepower production figure, which is continuing to climb, is almost a 300% increase over the company's average production of two years ago, he added. Mr. Vaughan also announced that peak production is expected to be reached late this year.

The Hudson Motor Car Co. (**A. Edward Barit,** president), early in January released an announcement that it has contracted with the United States Navy to build and operate a $13,000,000 ordnance plant near Detroit.

Another early January announcement was that Studebaker (**Paul G. Hoffman,** president) will soon begin production of Wright "2600" engines at South Bend, Ind., Fort Wayne, Ind., and Chicago. New facilities, including the three new plants and their equipment, will cost in excess of $49,000,000. The government will repay the cost of the plants over a period of five years and will take title to the plants at that time.

Buick (**Harlow H. Curtice,** president) is to erect a $24,313,000 plant, under a similar plan, for the production of Pratt & Whitney "1830" engines. This project alone, is expected to require 10,000 employees.

Ronan and Dunlevy Discuss Wear and Metallurgy of Diesel Fuel Systems

▪ ***No. California***

IN two papers, "Wear of Diesel Fuel Pumps" and "Metallurgy of Diesel-Engine Fuel System," John T. Ronan of Shell Oil Co. and Fred Dunlevy of Caterpillar Tractor Co., respectively, presented a quantity of interesting data to the Northern California Section at its recent diesel meeting.

Although each author dealt specifically with injection pumps manufactured by the Caterpillar company, representatives of four other Bay Area engine builders found the results and conclusions directly applicable to injection equipment used by them.

The high cost of injection pumps makes the control of wear an important item, said Mr. Ronan in describing the program of tests now under way at the Shell Oil Co. laboratory at Martinez, Calif.

With the object of determining just how thin a fuel oil can be and still have enough lubricating properties to prevent pump wear, Mr. Ronan said he had run six separate injection systems on clean fuels of various viscosities. He reported that 35 ssu was determined as the minimum viscosity to be recommended at the present time.

Dirty fuel is the most likely cause of pump wear, said Mr. Ronan in reporting on the second part of his tests. Comparison of pumps after operating 4000 hr using fuels containing a known amount of graded dust, showed 2 to 4 times normal wear, he said. The presence of iron and zinc contaminants, he added, likewise causes an increase in wear rate of from 3 to 5 times average.

The use of settling tanks is the most practical method of eliminating dust from diesel fuel, Mr. Ronan stated, adding that for satisfactory results the time required is from 8 to 12 hr per ft of depth. Commenting upon other methods of cleaning fuel, Mr. Ronan mentioned absorbent filters of the paper-disc-edge type as being good, but easily plugged. Centrifuging fuel oil is good but too expensive for most individual owners, he noted.

In answer to a question by Hans Bohuslav of Enterprise Engine Co., Mr. Ronan described pump wear as erosion at edge of plunger scroll near point of relief.

"What is the effect on wear of pre-heating diesel fuel?" Peter Glade of Purity Stores asked. He was advised that so long as the resulting viscosity does not drop below 30 to 35 ssu, temperature of the fuel makes little difference.

In reply to questions by Roy Hundley of Enterprise Engine Co. and James N. Mosher, Standard Oil Co. of Calif., Mr. Ronan described conditions of other parts of the fuel system as showing considerable signs of wear after operating on dirty fuel. Scuffing of plunger barrels was observed but hard to measure other than by the test method of measuring the weight of fuel pumped by a given number of strokes, he said.

The effect of various injection pressures and the effect of clarity or visionary appearance of fuel oils will be the subject of future tests, Mr. Ronan divulged in answer to a pair of questions by Mr. Hundley and Salazar Onorato of Union Oil Co.

Charles F. Becker, Tide Water Associated Oil Co., explained that the sources of zinc contaminants in diesel fuels are galvanized tanks and pipe lines. Such zinc increases wear and also causes deposits in the combustion chamber, said Mr. Becker. A. G. Marshall, Shell Oil Co., technical chairman of the meeting, added that while iron compounds cause as much or more wear than zinc, the former settles out rather quickly, therefore, he commented, iron fuel tanks are preferred to galvanized tanks. He added that use of settling tanks reduces wear by 30%.

Mr. Mosher reported that injection equipment operating in a logging camp had not been renewed in 7 years, and added that very great care was taken to remove dust from the fuel prior to use. Fred Dunlevy of Caterpillar Tractor Co. added that a fuel injection pump would operate 60,000 hr on clean oil, and not more than 200 hr on dirty oil.

The job of the metallurgist is to select that material which best meets the two conditions of successful manufacture and rendering satisfactory service to the customer, said Mr. Dunlevy in presenting his paper. Using a diagrammatic chart model of the Caterpillar injection system, the author named as the six most important parts, the plunger and barrel, nozzle and needle, check valve and seat. The material for these parts, he declared, must be selected with the objects in mind of mass production, machining, grinding, heat treating, surface finish, wear resistance, and availability of supply. Explaining his choice of SAE 52100 steel for these parts, Mr. Dunlevy stated its advantages as follows: It is rather readily available (already in use in ball bearings); its high yield strength allows fairly high speed operation of automatic screw machines; it grinds well either before or after heat treatment; lap finish, while not necessarily easy, gives a good result; distortion on heat treatment is small and well within the .001 to .002 allowed for finish grinding after heat treatment.

Very close chemical specifications, especially limiting incidental elements such as nickel, tungsten, vanadium and chromium, together with additional tests such as hot acid, micro structure, and hardenability, assures a product which will be absolutely uniform in quality, he stated. Effort thus spent in the metallurgy department, he added, is reflected in savings in every shop operation. The six most important parts of every set of injection equipment, earlier listed, are given hardness tests as an indication of their wear resistance under service conditions, he remarked.

Many other steels have been tried in the past, but discontinued for one reason or another, said Mr. Dunlevy, adding however that stainless steel of 17% chrome 1% carbon is used for certain conditions where acid is present in the fuel.

Diamond dust and levigated aluminia are the materials used in lapping close fitting parts, Mr. Dunlevy answered in reply to a question by Mr. Becker. In answer to questions by Sidney B. Shaw of Pacific Gas & Electric Co., Mr. Dunlevy reported that neither spectrograph analysis nor chrome plating of parts has been used. Plungers and barrels appear to have a super-finish, Mr. Dunlevy stated in answer to a question by Edwin C. Wood of Pacific Gas & Electric Co.

Mr. Bohuslav asked "What reasons lay behind the selection of copper for injection tubing?" He was told that the avoidance of steel splinters and chips left from the drawing process was the principal reason. In reply to a further question by Mr. Bohuslav, it was pointed out that installations using fuel of high acidity show wear of other parts such as pump tappets. Mr. Marshall questioned the use of copper injection lines under high acid conditions, but was told that such corrosion is not so important or evident as in close working parts.

Hydraulic Coupling Advantages Cited

■ *Kansas City*

Adoption of the hydraulic coupling in conjunction with fluid transmission in automobiles is probably the greatest improvement since the introduction of hydraulic brakes, was the opinion of D. F. Toot, Chrysler Corp. engineer, at the Dec. 1 meeting of the Kansas City Section. Sharing the spotlight was J. B. Bender, electrical engineer of the Wittee Engine Works, who delivered a comprehensive paper entitled "Small Diesel Powerplants."

Following a brief review of the 35 years of hydraulic-coupling history, Mr. Toot, in his paper, "The Hydraulic Coupling and Its Fluid Drive Application," outlined the advantages of the current Chrysler fluid drive.

Elimination of engine stalling tendencies; accurate control of idling speeds by means of the throttle alone; perfect damping of torsional vibration; effective cushioning for sudden shock loads; and provision of an effective starting torque about as great as peak torque, are some of the aids this type of mechanism offers internal-combustion-engine operation, Mr. Toot said.

Stressing fatigue as one of the greatest contributors to traffic accidents, the speaker pointed out that the new fluid drive has eliminated the tiring action of moving the right foot back and forth from the brake pedal to the accelerator by permitting left-foot braking.

"The automotive engineer has found in the hydraulic-coupling equipped engine," Mr. Toot said, "a powerplant which in smoothness of operation and in torque delivery approaches the steam engine, without incorporating all the disadvantages of the latter."

Mr. Bender launched into his subject with the arresting statement that mechanical efficiencies of small diesel engines (4 hp-

36 hp) very nearly approach those of larger units, thus making it possible for the owner of a small powerplant to enjoy operating costs comparable to those of large powerplants. This has not yet been achieved, Mr. Bender said, by other types of prime movers, such as steam engines.

Focusing attention on the responsibilities of the manufacturer of small diesel units used for commercial power and lighting, the speaker said, the units must be reliable and safe, reasonably simple and easily serviced, and must represent a financially sound investment.

Sparrow Gives Hints On Engine Lubrication

■ *Chicago*

Pick the oil! Pump the oil! Preserve the oil! These three primary principles formed the basis of one of the most enlightening papers ever presented to the Chicago Section by its Fuels and Lubricants Activity.

Presenting his paper in a fast-moving style, interspersed with appropriate humor, Stanwood W. Sparrow, head of the engineering research department of The Studebaker Corp., held the interest of the 200 members and guests of the Chicago Section while he discussed the problems of engine lubrication in modern motor cars at the Chicago Towers Club, Dec. 3.

Illustrating his talk with lantern slides, Mr. Sparrow outlined the advantages and disadvantages of low viscosity oils. On the advantage side he placed quicker starting, faster lubrication to bearing surfaces, more power output, and better economy. On the disadvantage side he mentioned lower oil mileage, increased blowby and less protection for rubbing surfaces. Thin oil causes wear of engine parts when the surfaces are not up to par, continued the speaker, but there is every incentive to use light oil. Engine design points to wider use of light oil, and improvements have helped to extend the use of lighter oils, he commented.

Touching on engine oil filters, Mr. Sparrow stated that filters preserve engine oil and help keep bearings clean. Filters also offer the additional advantages of keeping oil rings free and reducing varnish conditions in the engines, he added.

Proper sealing in building and servicing engines is of vital importance, Mr. Sparrow said, and he feels that there is room for improvement in gasket design and manufacture.

Technical Chairman, Walter G. Ainsley of Sinclair Refining Co., introduced Mr. Sparrow and kept a lively discussion going after the speaker had finished. Leading the discussions were Herb Packer, *Motor Service;* W. B. Ross, Pure Oil Co.; Walter Blaine, *Chek-Chart,* Detroit; E. R. Barnard, Standard Oil Co. (Ind.); Ted Robie, Fairbanks, Morse, and Howard Pile, *Chek-Chart.*

Hydra-Matic Performance Discussed by Youngren

■ *Milwaukee*

Oldsmobile's chief engineer, Harold T. Youngren, gave members and guests attending the Dec. 13 meeting of the Milwaukee Section highlights on the development of the Olds' Hydra-Matic transmission, flavored with an off-the-record preview of data comparing its efficiency to that of competitive transmissions.

Use of the Hydra-Matic transmission, which does not require time out for shifting, increases the acceleration of the car so that it will go from zero to 60 mph in 18½ sec as compared with 22 sec required for a car with a standard transmission, Mr. Youngren told his listeners. The time from zero to 25 mph is 4.8 sec, he added.

It was explained that the speed at which shifts occur are a function of the accelerator position, and occur at higher speeds with the accelerator further down.

The present Hydra-Matic transmission was shown to have a very smooth external appearance with only two outside adjustments, which are for the brake bands. Mr. Youngren reported that several of the transmissions have completed 20,000 miles of endurance testing without requiring any adjusting of the brake bands, indicating that these adjustments are not often used.

Mr. Youngren explained that the oil used in the transmission is called "transmission fluid" in order to prevent use of anything in the transmission that is usually called oil. The fluid, he said, is a mixture of 10W and 20W oil having a high stability in order to eliminate the formation of varnish. The temperature of the oil normally will be be-

tween 80 and 100 F above air temperature. The lubricant has a viscosity of 45 sec Saybolt at 210 F, he stated, adding that the transmission is designed to operate satisfactorily on the same oil at air temperatures ranging from — 15 to 115 F. Mr. Youngren further explained that the oil with which the transmissions are originally filled at the factory has inhibitors to increase the oiliness of the oil during the original break-in period as well as to prevent formation of varnish.

Overhauls Infrequent For Diesel Locomotives

▪ Dayton

"Diesels Working on the Railroads," a talk by Frank Prescott, vice president, Electro-Motive Corp., gave 140 Dayton Section members and guests some inside facts on diesel-electric locomotives at the Jan. 6 meeting.

The automotive engineers learned that no figure has been developed on mileage between overhauls because data is too scarce. He told them that the Burlington 3000-hp "City of Denver" locomotive ran 700,000 miles before being taken off for overhauling. The job was completed in 10 days, he said, and since has run another 800,000 to 900,000 miles. The 4000-hp Chicago & Northwestern "400" locomotive is going strong at over 400,000 miles and is running on a basis of about 98% availability. The locomotives put out by his company, he said, are guaranteed against defects, etc., for 100,000 miles or one year.

Diesel switching locomotives, he brought out, save enough to pay for themselves in four or five years. Available 24 hr a day, they use comparatively little fuel, and three diesel locomotives can do enough work to take the place of four steam locomotives, he said. They can save about 20% in switching jobs, he added.

Many of the crack diesel-electric locomotives and trains were shown in the film, "Five Years of Diesel Locomotive Development," which was shown accompanying Mr. Prescott's talk. One of the most interesting shown was a 5400-hp freight locomotive. This job consists of four cabs of 1350 hp each, and has now run a total of 77,000 miles, it was explained. It weighs 950,000 lb and has 225,000 lb tractive effort, with all the weight on the drivers, Mr. Prescott said. He also noted that the locomotive rides so good, with no side-sway or diving, that the engineers really appreciate it.

Students Elect Officers

Meeting Jan. 8, members of the SAE Student Branch at the University of Oklahoma elected T. Herbert Freeman chairman for 1941. Other officers elected were: Harry B. Musser, vice chairman; Rex S. Sutton, secretary-treasurer; Charles Phil Brooks, representative to St. Pat's Council, and Merle W. Lucas, program chairman.

About Authors

(Concluded from page 15)

▪ A. M. ROTHROCK *(SM '40) graduated from Pennsylvania State College with a B.S. in physics in 1925. He continued at Penn State as graduate assistant until 1926 when he received his appointment to the Langley Memorial Aeronautical Laboratory of the National Advisory Committee for Aeronautics. As a member of the technical staff he has been conducting research on fuel injection and combustion phenomena in diesel and spark-ignition engines. Since 1929 he has been in charge of research on these projects. Mr. Rothrock is an Associate Fellow of the Institute of the Aeronautical Sciences, and a member of the NACA Subcommittee on Aircraft Fuels and Lubricants.*

▪ R. A. WATSON *(M '36), as engineer in charge of the Pacific Coast Division of Federal Mogul Corp., has been in close contact with most major fleet operators in the far-western states and knows their bearing problems from A to Z. These contacts, plus years of technical experience in his field, have given him a valuable store of information to call upon for his paper "Major Causes of Bearing Failures." Mr. Watson is chairman of the SAE Northern California Section. Aside from his technical ability, he is a fisherman of note – winner of the Salmon Derby held in connection with the West Coast Transportation & Maintenance Meeting in Seattle last summer.*

Larger Trucks Foreseen For Express Highway Use

■ New England

Larger trucks carrying much heavier loads over express highways, some of them operated on a toll basis, were predicted as a result of the national defense program, by J. F. Winchester, Standard Oil Co. of N. J., in a talk before the New England Section, Jan. 14. He said that War Department plans, now building up on a huge scale into what will be permanent defense for this country, will require larger transportation units – and to make it feasible for them to move at reasonable speeds, the new type of highways will be necessary.

There is already talk of such planning, Mr. Winchester stated, citing references he saw in Boston newspapers upon his arrival, to either new or widened highways serving Army camps. He also called attention to the paper, "Toll Roads and Truck and Bus Transportation," presented by Charles M. Noble, Pennsylvania Turnpike Commission, at the SAE Annual Meeting in Detroit. *(A digest of Mr. Noble's paper appears on page 44).*

Commenting on the 160-mile Pennsylvania Turnpike, Mr. Winchester said that there already is talk of projects to extend the highway westward toward the Great Lakes and then on to St. Louis, and eastward through New Jersey into New England, with another link going south into Virginia.

There will be opposition to building larger commercial vehicles to operate over these highways by those interested in other forms of transportation, Mr. Winchester said, adding, however, that if the impetus of the defense program continues to grow with Federal backing, the bigger units will be made.

Naturally the big factor in building express toll highways skirting busy cities will be the initial cost, Mr. Winchester said. Federal and state funds, he explained, will be available for some roads, and in certain sections the highways will be financed by private capital through issue of revenue bonds that would repay the investor from tolls collected, and have provisions for the highway to go to the state at the end of a period of years. "There does not seem to be the antagonism toward toll roads that there was 10 or more years ago," he commented.

Concluding, Mr. Winchester said: "If all the gasoline-tax money diverted from road building, an amount totaling more than a billion dollars, had been used by the states as the motorists anticipated, we would have today thousands of more miles of fine roads. Why motorists in every state do not fight against diversion seems strange. Where they did so in some states they were successful."

After his talk, Mr. Winchester showed several moving pictures illustrating the efficiency with which fires on big gasoline trucks are extinguished. He explained that such fires are much less frequent than they were a few years ago.

New Members Qualified

(Concluded from page 63)

Syracuse Section

Bentley, Harold B. (A) draftsman and estimator, Union Forging Co., Endicott, N. Y.

Outside of Section Territory

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SAE Officers Speak On National Defense

■ Pittsburgh

National defense was the theme of the Pittsburgh Section's Dec. 17 meeting, as one of the largest crowds of the year turned out to welcome SAE President Arthur Nutt and General Manager John A. C. Warner.

Reporting on what he saw while in France just before its collapse, Mr. Nutt, who is vice president in charge of engineering, Wright Aeronautical Corp., titled his paper, "Lessons Learned from the European Aircraft Industry." Mr. Warner's topic was "SAE in National Defense." Major points of both speakers have been included in reports of earlier talks made by the national officers before other Sections of the Society.

Among those answering the call for discussion of the papers were: Dr. W. A. Gruse and C. J. Livingstone, Mellon Institute of Industrial Research; Charles R. Noll, Gulf Oil Corp.; Ralph Baggaley, Jr., McCrady-Rodgers Co.; Harry W. Boord, American Oil Co.; Fred Haller, and J. A. Harvey, Pittsburgh Motor Coach Co.

Smaller, High-Output Car Engines Predicted

■ So. California

William H. Hubner, refinery technology division, Ethyl Gasoline Corp., suggested that future engines will be units of smaller size, having higher compression ratios, yielding higher power output and greater fuel economy, and requiring fuels of higher antiknock properties, in his paper, "The Fuel Factor in Future Engine Design," which he presented at the Southern California Section meeting, Dec. 13. It seems probable, he said, that in the future more emphasis will be placed on improving economy as well as performance.

Speaking of fuel, Mr. Hubner stated that although the trend has been toward more volatile fuels, apparently a leveling-off point has been reached. The importance of low gum content and good storage stability were stressed by the speaker, who also noted that sulfur content is becoming less important so far as corrosion problems are concerned. Reduction in sulfur, he added, is now largely a question of the economics of producing high-octane fuels.

In presenting his paper, Mr. Hubner brought to the Southern California audience many of the points made in "Better Fuels for Better Engines," a paper which he read at the 1940 Summer Meeting of the Society, and which was printed in the October SAE Journal (Transactions, page 409).

"It is time that vehicle manufacturers bring their cars up to date," Fred Olson, manager, research department, General Petroleum Corp., declared in rising to discuss Mr. Hubner's paper. "The transmission," he said, "is a relic of the dark ages. . . . The front engine with its multiple units for getting power to the rear wheels should give way to the rear engine. As it is, we have to throw unlimited quantities of gasoline away to overcome deficiencies in automotive design."

Among others called upon for discussion by Technical Chairman C. E. Emmons were Fred Barrons, Wilshire Oil Co., who supported Mr. Olson's contentions, and C. R. Johnson of the Shell Oil Co.

The meeting was opened by Section Chairman Dr. Ulric B. Bray. Vice Chairman for Fuels & Lubricants, Carl Abell, took over, and presided at the dinner which was attended by 132 members and guests. At the opening of the technical session he called upon Dr. C. E. Emmons, chief chemist, The Texas Co., to introduce the speaker and conduct discussion.

Hubner Addresses Students

■ Oregon State

At a recent joint meeting with the student group of the American Society of Chemical Engineers, members of the SAE Student Branch at Oregon State College heard W. H. Hubner, refinery technology division, Ethyl Gasoline Corp., present his paper, "The Fuel Factor in Future Engine Design." Mr. Hubner's remarks were similar to those he made before the Southern California Section, Dec. 13, reported above.

Some 80 students and faculty members were present, and they fired questions at Mr. Hubner which kept discussion going for more than an hour. Harry Kuhe, manager for Ethyl in the Northwest, and his assistant, Bob Mead, accompanied Mr. Hubner on his visit to the campus.